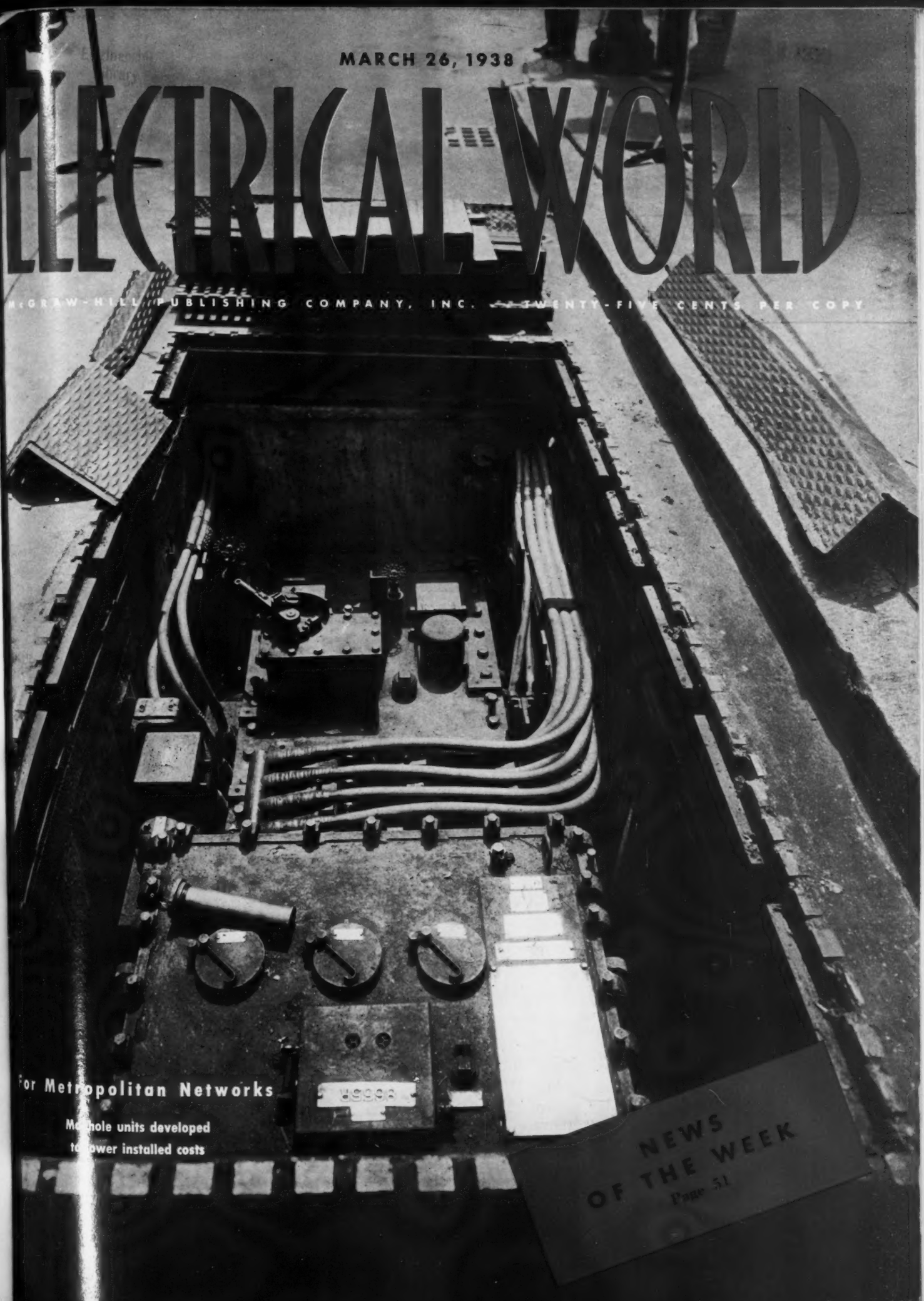
MARCH 26, 1938

ELECTRICAL WORLD

McGRAW-HILL PUBLISHING COMPANY, INC. TWENTY-FIVE CENTS PER COPY



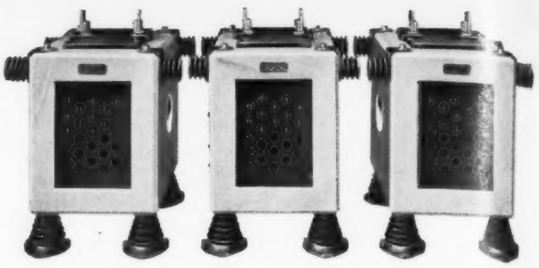
For Metropolitan Networks

Manhole units developed to lower installed costs

NEWS OF THE WEEK

Page 51

IN SPRINGFIELD
MASSACHUSETTS
AS IN MANY OTHER METROPOLITAN AREAS



Indoor Dry Type Feeder Reactors Rated 188 K.V.A., 628 Amperes, 23 K.V., 60 Cycles

MURRAY CURRENT LIMITING REACTORS

Murray Current Limiting Reactors afford protection towards continuity of service, reduce stresses on plant equipment and isolate the disturbances to the affected area next or near the short circuit. They are supplied for all kinds of services—indoor or outdoor—for operating voltages up to 33 K.V. and current ratings up to 5,000 amperes.

Murray Dry Type Reactors consist of concentric stranded, enameled and asbestos insulated conductors mounted in a concrete housing.

For over a quarter century Murray Reactors have been providing short circuit protection on the lines of many of the largest systems. Efficiencies guaranteed. Metropolitan Device Corp., 1250 Atlantic Ave., Brooklyn, N. Y.

PROTECT DISTRIBUTION SYSTEMS

ELECTRICAL WORLD

MARCH 26, 1938

TVA Investigation Inescapable

America is to be congratulated that it has a man with the courage of Dr. Arthur E. Morgan, who is willing to run the risk of open presidential displeasure merely to defend what he believes to be right and to protect the interests of the public, which, as chairman of the TVA, he felt had been intrusted to him. Dr. Morgan, who asks for nothing for himself, by his very sincerity in opposing the ultimatums of the President has nevertheless won an unassailable position in the hearts of American citizens.

Dr. Morgan, however, might have been spared the humiliation of being removed from TVA by the President had he submitted to Congress a minority report at the same time the majority TVA report was made. Then it is doubtful if the President could have interfered and a public investigation would have had to follow quickly, pretty much along the lines of the minority report.

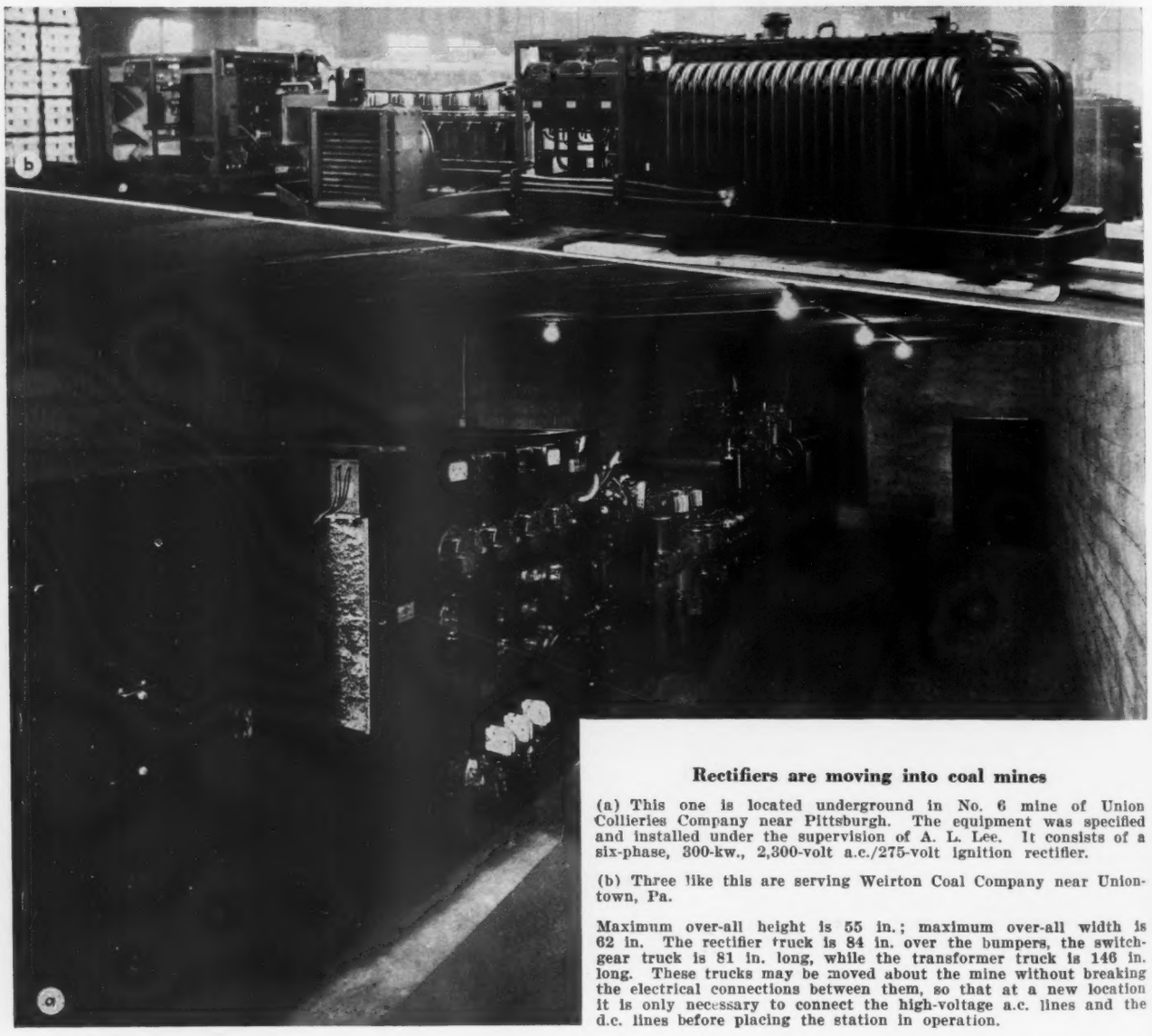
However, only time has been lost, for it now must be apparent to everybody that a Congressional open hearing is inescapable. Not only that, but the matter has been so well aired in the newspapers that the public will be satisfied with nothing short of a thorough investigation. The public wants to know exactly what has been going on behind the scenes with respect to the Berry marble claims, the purchase of phosphate lands at a half-a-million profit to the seller and the power contracts with certain large corporate interests. The public, furthermore, has heard all along how cheaply TVA can make and sell power, but it has seen no accounting. The public was told that TVA power was to be used to improve the condition of the people in the territory by supplying them with unlimited quantities of low-priced electricity, but the power instead has gone to large interests. The public wants to know if these large power contracts are profitable. The public now wants to know what TVA costs and what is the return.

There is no telling what the outcome of the investigation may be. An effort will be made to include further mud slinging against private utilities for anti-TVA activities. The herring, however, does not have as strong a scent as it once had. Therefore, what effect the investigation will have upon the future course of government in power production and distribution is anybody's guess at the moment.

It would be foolish to suppose that the investigation would result in the withdrawal of the government from the power business. There is an immense investment in the TVA property which government alone can handle. Moreover, a well-operated governmental power agency with proper allocation of costs might in the long run be an excellent thing for the private power industry. Through such an agency the government might impose an indirect regulation of rates, while at the same time the public would have a living example of how little is to be gained by switching from private to public ownership.

In any event, the investigation should bring to light all of the hidden mysteries of TVA. It should result in a power policy that is not ashamed of the light of day. It should result in a rate for power that is based upon accurate accounting. If it claims to be a yardstick, it should be a true yardstick and not a mirage. It should result in an administration policy based not upon animosity and dictatorship, but upon fair play and reasonableness. Only through such a thorough, open investigation can any stigma against TVA and other government power agencies be removed and public confidence be restored. The investigation will do a world of good to clarify the entire power situation.

Rectifiers Fit the Needs of



Rectifiers are moving into coal mines

(a) This one is located underground in No. 6 mine of Union Collieries Company near Pittsburgh. The equipment was specified and installed under the supervision of A. L. Lee. It consists of a six-phase, 300-kw., 2,300-volt a.c./275-volt ignition rectifier.

(b) Three like this are serving Weirton Coal Company near Uniontown, Pa.

Maximum over-all height is 55 in.; maximum over-all width is 62 in. The rectifier truck is 84 in. over the bumpers, the switchgear truck is 81 in. long, while the transformer truck is 146 in. long. These trucks may be moved about the mine without breaking the electrical connections between them, so that at a new location it is only necessary to connect the high-voltage a.c. lines and the d.c. lines before placing the station in operation.

PARTICULARLY with respect to power supply, the coal mining industry is undergoing a profound change. Mechanization and concentration of face operations and changes in the working day have altered power requirements so that the conversion substation has risen in importance. It demands ease of frequent relocation and minimum attention and maintenance. The ignition rectifier is meeting the situation economically, efficiently and capably and knock-down substation structures are being used to add to the inherent mobility of the rectifier assembly.

The ignition rectifier is admittedly at a disadvantage in comparison with the single-tank rectifier in that the life of the ignition tube, an auxiliary, is limited and such a six-phase rectifier has approximately twice as many vacuum seals as does the single-tank rectifier. The advantages of the ignition type rectifier are that it is smaller in physical size than the single-tank rectifier of the same capacity, hence, lighter and more portable; voltage regulation is more easily obtained through phase shift of the voltage to the grids of the firing tubes; inspection and maintenance are easier, due to the smaller physical size of the parts involved. Three tanks of a six-phase unit may be shut off, in case of a failure in one tank, and emergency power supplied for pumps and fans, at reduced voltage, as a three-phase rectifier; due to its shorter arc path, its efficiency is higher than that of a single-tank rectifier.

The ignition type rectifier would seem to provide the mining industry with a substation no more expensive than contemporary substations. Such a substation, however, is much more portable than any other present-day substation. It may be kept at the face of the coal mining operation, thus reducing distribution losses; it requires little attention, since there are no bearings to replace and few

Coal Mining Operations

By A. LEE BARRETT
Electrical Engineer, Pittsburgh, Pa.

moving parts to wear out; it is unusually resistant to damage by lightning; it provides highly reliable automatic control; its efficiency is substantially better than anything heretofore available.

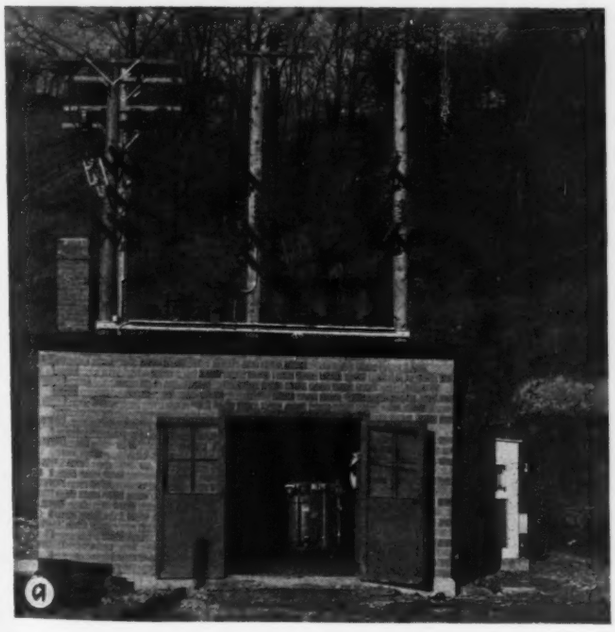
Daily operation undergoes change

Whereas in 1930 the average coal mine had an eight-hour day and a six-day week, it now operates on a seven-hour day and a five-day week. In 1930 most mines operated one shift per day. In order to hold production at the former level. as well as to increase efficiency, many mines today operate two, and some three, shifts daily. The mechanization trend in itself tends to concentrate mining activities to a smaller area and concentration is being used on its own merits to improve the efficiency of mine operation.

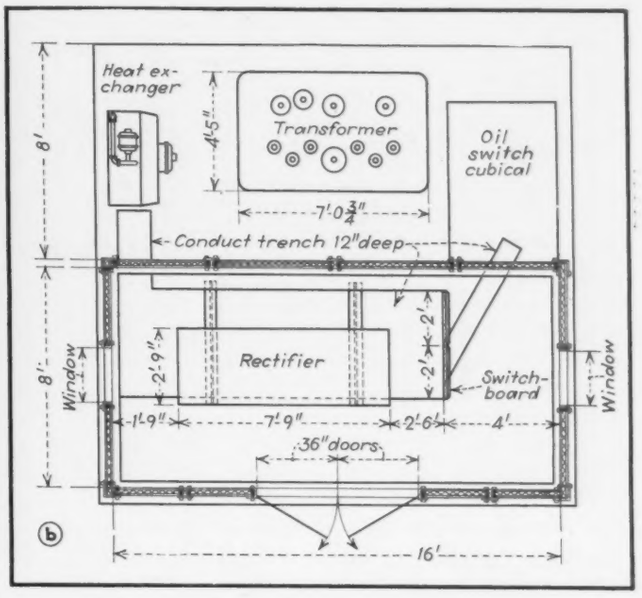
All of these factors necessarily have had an effect on the conversion equipment, on the load factor and on the d.c. distribution system. The tons mined per kva. of demand and the kilowatt-hours per ton mined today stand at figures not greatly differing from those of 1930, but the daily load factor has increased materially. In the case of a rather large group of mines the tons mined per kva. have decreased 4 per cent, while the kilowatt-hours per ton mined have increased 4 per cent, but the daily load factor has increased about 15 per cent. The small change in these monthly factors, in spite of the shorter working day and week, has been made possible by a more efficient use of machinery and equipment.

At any mine there are certain pieces of equipment for which the power consumption is more or less definitely fixed, such as the mine fan and the mine pumps. These classes of equipment usually represent 30 to 35 per cent of the mine power consumption. Increased production made possible by double shifting and mechanization, together with concentration, has allowed for an increase in the power consumption at the face of the mine without an increase in these fixed power charges. The daily load factor of the mine has materially improved, so that the general changes in mine operation have not, in most cases, required additional conversion equipment.

Mechanization has, however, made



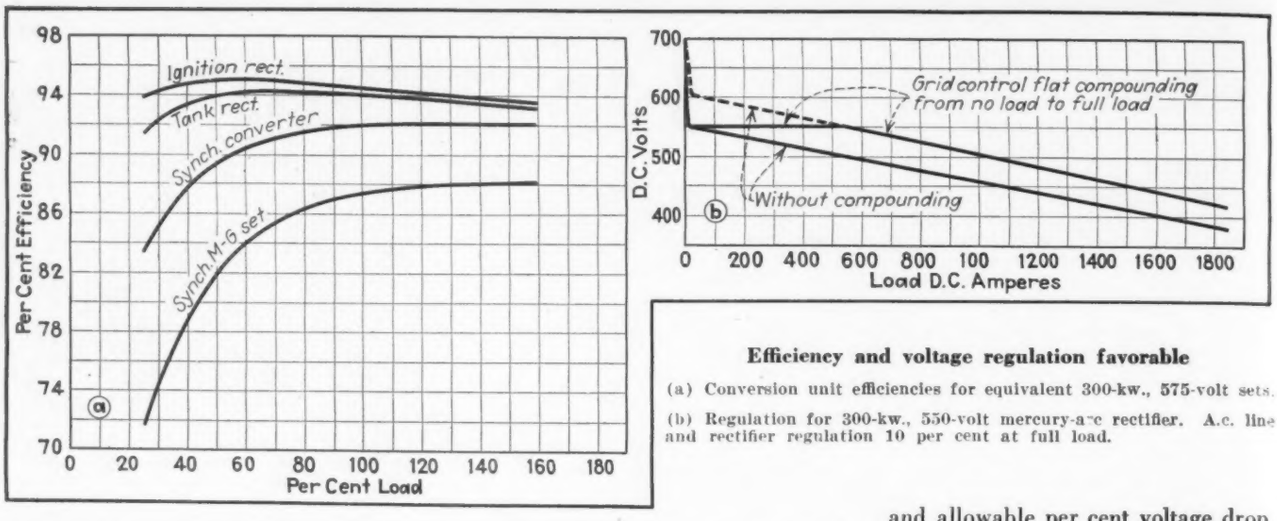
(a) Single-tank rectifier station of 600 kw. occupies only 240 sq.ft.



(b) Multiple-tank rectifier installed in 8x16-ft. demountable building. The rectifier, with dimensions of approximately 3x8x3 ft. high, will be located immediately behind the automatic switching equipment, which will be mounted on two panels 24 in. wide by 90 in. high. The building will house only these two units. The heat exchanger, control transformer and main transformer will be outdoor equipment and, though located on the same foundation, will be outside the substation building. The oil switch will be housed in a small weatherproof cubicle and will also be located outside the substation building.

The substation building will have insulated, fabricated steel walls and roof and will knock down in five pieces—four walls and the roof. All piping and conduit will be located in covered ducts in the foundation. Terminal boards located on each piece of apparatus will provide for easy disconnection or wiring, which will run in conduit between the units. When the substation is dismantled these connections may be opened and the conduit clamps released. Then the conduit, together with all the wiring, may be moved, transported and reinstalled intact, eliminating the necessity of rewiring the relocated substation. Further, there will be no more than four conduits. The oil switch housing will contain the oil switch, lightning arresters and instrument transformers, making a small and readily portable unit. The heat exchanger, together with circulating pump and motor, will be self-contained and portable.

Rectifier installations are compact



Efficiency and voltage regulation favorable

(a) Conversion unit efficiencies for equivalent 300-kw., 575-volt sets.

(b) Regulation for 300-kw., 550-volt mercury-arc rectifier. A.c. line and rectifier regulation 10 per cent at full load.

marked changes in the mine load distribution. In 1930, in the usual case, 75 per cent of the load was the result of mine haulage, while 25 per cent of the load was the result of operations at the face. Under these conditions the mine a.c.-d.c. haulage substation could be economically located along the haulage way at a point which would remain more or less fixed throughout the life of the mine. The mine face in 1930 advanced slowly and covered a wide area, so that a face substation, which handled about 25 per cent of the load, could remain at one location for a long time, usually ten to fifteen years.

Half energy used at mine face

Mechanization and concentration have greatly changed this picture. We now find that 50 to 60 per cent of the mine's d.c. load is consumed at the operating face and that the area covered by this working section is greatly reduced. For example, one mine which in 1930 had approximately 900 working rooms and a production of 6,400 tons per day now has 36 working rooms and a production of 5,500 tons per day. The location of the haulage substation is the same as it was in 1930. The face substation, however, is larger and must be moved much more often in the future than was necessary in 1930.

Considering the case of a 6,000-ton mechanical mine operating three shifts, we find that the working area is approximately 5,000 ft. long. On the basis of usual mine operation and 5-ft. coal, this face will advance 1,560 ft. each year, or 7,800 ft. in five years. In other words, at the end of five years, the mine substation will be 7,800 ft. from the face, if it were at the face at the beginning of that period. The d.c. voltage at this mine is 550 and the maximum instantaneous d.c. demand is approximately 1,400 kw., half of which is used at the face and half by the mine haulage. The face substation will thus have a maximum d.c. load of 1,270 amp. If the instantaneous allowable voltage drop is set at 20 per cent, or 110 volts, the resistance of the circuit must be not more than 0.078 ohm.

At the end of the five-year period two 1,000,000-circ.mil cables will be required for the trolley circuit, and if 60-lb. rail is used a 1,000,000-circ.mil cable will be required on the ground circuit. Under the best of conditions this would require 72,000 lb. of copper, worth approximately $10,800, without having included the cost of switches or installation labor and material. Since the distribution copper cost varies as the square of the distance from the load center for a given per cent voltage drop, distribution copper costs will mount even more rapidly for distances greater than 7,800 ft. Good performance of equipment requires that maximum voltage drops do not exceed 20 per cent, so that it is impractical to reduce the amount of copper. The obvious solution to the problem is to keep the face substation near the face. A distance of 7,800 ft. seems to be the logical maximum distance. This requires the face substation to be moved approximately every five years.

Mines with 250-volt distribution are even less fortunate, since, with the same total amount of copper and allowable per cent voltage drop, the substation can be one-half as far from the face and, hence, must be moved approximately every 2½ years.

Substation has to move more often

A substation which must be moved every five years, instead of every fifteen years, should be designed to facilitate relocation. In the past mines have used motor-generator sets or rotary converters for a.c.-d.c. conversion. Installation and relocation of these stations has, in general, been expensive due to the foundations and to the size of building required. Usually they were non-automatic. The substation operator was frequently also in charge of the lamp house and the mine fan, which were often located near the substation.

Two rectifier substations have been installed by the Pittsburgh Coal Company, Pittsburgh, Pa., in the past year as a means of meeting the new condition. They have provided high efficiency and reliable automatic control. The installation cost has been greatly reduced, since the size of the building was small, approximately 15x16 ft. inside dimensions, for a 600-kw. substation.

Rectifier substations now being designed are of the ignition, or multiple-tank, type. A 600-kw. station of this type will be housed in a fabricated building whose inside dimensions are 8x16 ft.

Practically speaking, such a station will consist of one building in five parts, one heat exchanger, one rectifier complete with excitation apparatus, one main transformer, one oil switch unit, one switchboard and

[*Continued on page 98*]

Repeater Fuse Spill Gaps Reduce Lightning Outages

No transformer failures in six years' operation where fused gaps have been installed—Effective protection of older equipment afforded by practicably closer gap settings

By M. H. LOVELADY

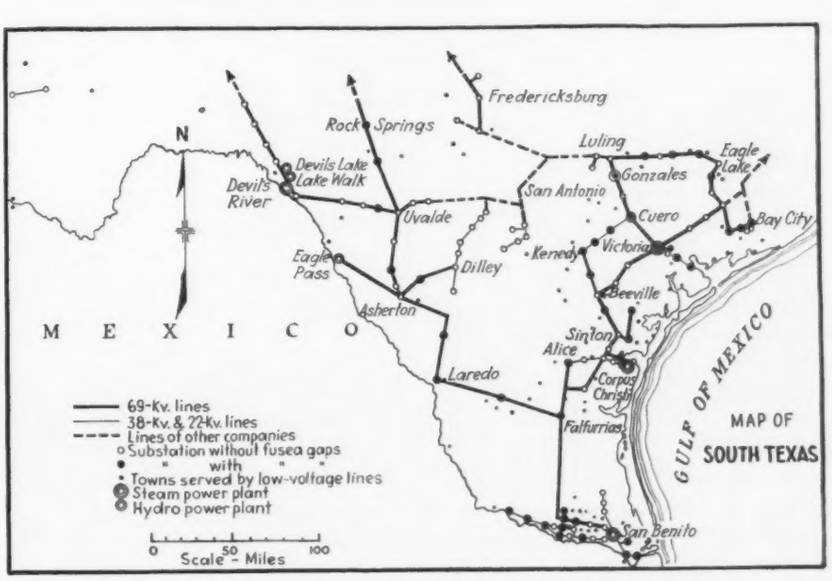
Electrical Engineer Central Power & Light Company, San Antonio, Tex

PERFORMANCE of repeater type fused spill gaps on the system of the Central Power & Light Company in southern Texas has been most satisfying. No transformer failures, no bushing failures, no bushing flashovers have occurred where gaps are installed. Out of 632 gap operations in two years, shown in the accompanying tabulation, only two were accompanied by blowing of transformer fuses, and these were probably due to faulty fuses because a number of gap operations have since occurred at these locations without transformer fuse openings. In the two-year period there were no gap tube failures and only one tube flashover, this initiated by birds at an installation where clearance for expulsion of gases was insufficient. Shorting out gaps by birds caused twenty of the 632 operations. These twenty caused no system disturbances, their only results being the not serious ones of fuses lost from the repeater series. Only two operations can be ascribed to switching surges, occurring during periods of no visible lightning and not otherwise explained.

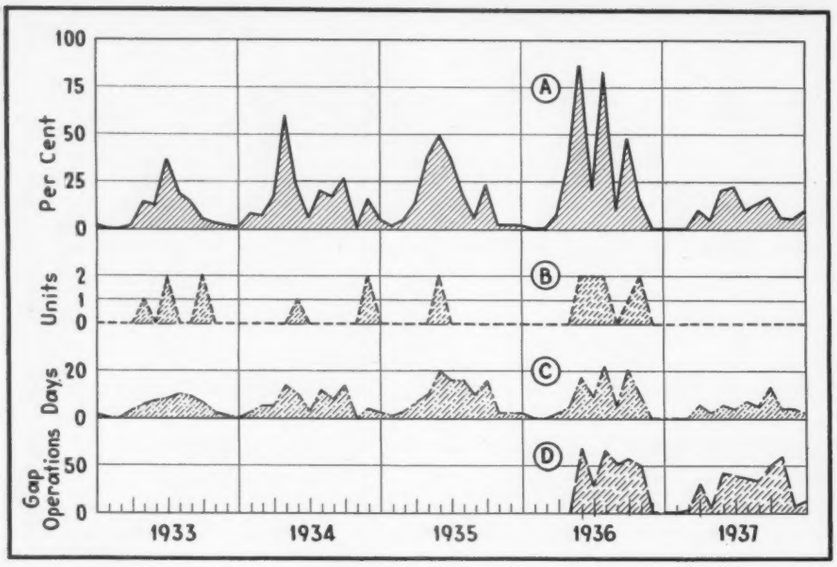
The system of the company (see map) covers an area of 66,000 square miles and traverses all types of terrain, mountainous, plain, desert, valley and coastal. Temperatures vary from zero in the hill country to 114 in the shade in the arid sections. With such varying topography and climatic conditions, nature has all of the ingredients required to create severe, frequent and lengthy lightning storms. At times there are three or more separate and distinct storms over different parts of the transmission system. Often it seems that a storm will start in over the northeastern end of the system, travel down our lines to the Gulf, then come back with reinforcements to retrace its path.

Centers of load density are far apart and long lines and small substations are numerous, 173 towns and communities are served by 134 high-voltage substations, 3,000 miles of high-voltage and thousands of miles of low-voltage lines. There are four steam-electric plants, five hydro-electric plants and ten interconnections with three other large power companies. The class of business served is varied, irrigation, mining, factory, oil pumping, refining and many others, as well as domestic and general commercial service.

Knowing the severity of lightning storms in this territory, company engineers have naturally provided as much lightning protection as can be justified. All stations are equipped with arresters on both high and low voltage. Most stations are protected by ground wires over the station and extending one mile out on each transmission circuit. Several lines are equipped with overhead ground wires and one is equipped with two overhead ground wires for its entire length. A few sections of line have been equipped with crossarm gaps to prevent shattering of the arms and expulsion

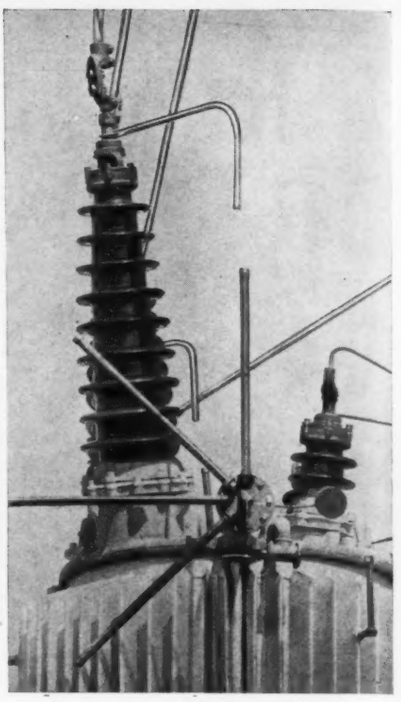


System of Central Power & Light Company in South Texas



The lightning record

These curves show the severity and frequency of lightning disturbances in the south Texas area. Curve A, ratio of number of transmission line trip-outs to number of lightning storms, indicates the severity of disturbances. Curve B shows the number of transformer failures from lightning. Curve C shows days each month when there was lightning over the system. Curve D shows gap operations—103 gaps in service in 1936 and 184 in 1937.



Four-shot repeater fused gap

tubes have been installed on a few line structures. On a number of lines, particularly in the coastal area, where leakage is severe, the insulator pins and suspension eyebolts are grounded. All substation grounds are maintained at a low resistance level.

The one piece of equipment whose failure can cause the most lengthy and costly service interruption is, of course, the substation transformer. The C. P. & L. system has 316 substation transformers rated 33 kv. and higher in service (spares excluded). Here is the record of transformer failures by lightning for the past ten years.

1928—5	1929—5	1930—5
1931—3	1932—3	1933—5
1934—3	1935—2	1936—9
	1937—0	

Company engineers considered this number of failures rather high and several years ago started looking for some means to reduce them. The main requirement to prevent such failures being to limit the maximum voltage that can appear between the winding and tank to a value as near the normal operating voltage as possible, several points were selected where transformers had been damaged by lightning on more than one occasion and spill gaps installed. They were placed directly at the transformer bushing to prevent any possibility of a potential difference between the gap location and the transformer terminal. Simple expulsion fuses were installed in series with the gaps and the transformer case, the case, of course, being at ground potential. The fuse element is a No. 36 copper wire and will readily clear the follow-up current in less time than required to operate the transformer fuse.

The opinion was that the lower the gaps could be set without excessive operations due to surges other than lightning the more protection would be afforded the transformers, some of which are rather old and probably contain insulation that had deteriorated to a rather low level. Others are of questionable design and not capable of withstanding very high surge voltage. We immediately learned that the gaps could be set for a much lower flash value than was previously thought possible. The 12-kv. gaps were set 1.25 inches, 22-kv. two inches, 38-kv. four inches and 69 kv. six inches. This corresponds roughly to a ratio of normal line to neutral voltage as follows: For 69-kv. systems 1.35, for 38-kv. systems 1.87, for 22-kv. systems 2.2 and for 12-kv. systems 2.85. So far as can be determined, there have been no excessive operations of the gaps due to transients other than lightning. All transmission circuits have solidly grounded neutrals at all power sources, so that it is quite impossible for the normal frequency line to neutral voltage to rise to an excessive value.

It will be seen that with the low ratios mentioned, the flash value of the gap is well below that of conventional protective equipment. Also with low gap settings the time lag due to the rod gap is not great. The 6-in. gap, for instance, with a $1\frac{1}{2}$ x 40 microsecond negative wave,

[*Continued on page 102*]

Performance of Repeater Fused Gaps

Line Voltage	Gap Setting, Inches	No. of Installations 1936	No. of Installations 1937	Operations Between Inspections: One Tube 1936	One Tube 1937	Two Tubes 1936	Two Tubes 1937	Three Tubes 1936	Three Tubes 1937	Four Tubes 1936	Four Tubes 1937	Total Operation 1936	Total Operation 1937
66 kv.	6	60	88	69	61	22	17	8	7	9	2	173	124
38 kv.	4	16	30	30	40	15	5	2	4	2	3	74	74
22 kv.	2	9	21	19	6	4	2	2	0	0	1	33	14
12 kv.	1.25	18	45	16	46	8	25	2	2	0	0	38	102
Total		103	184	134	153	49	49	14	13	11	6	318	314

Design Station Cables on Conservative Basis

By F. H. BULLER

Central Station Department, General Electric Company, Schenectady, N. Y.

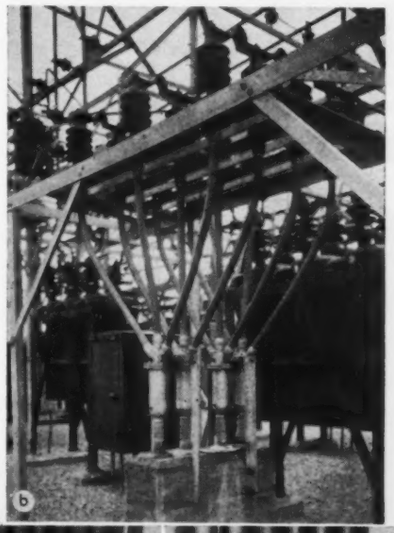
WIRING generating stations, substations, large industrial plants and other buildings where large blocks of power are used is a problem that can usually be solved by the use of one or more of the standard types of cables. However, many special application problems are often presented by such installations and situations are frequently encountered where otherwise minor features of ordinary application assume major importance. Factors that should be observed in selecting a station cable are assembled in the accompanying panel.

Conductors are usually of standard strand construction up to 1,000,000 circ.mil and of annular or segmental construction above 2,000,000 circ.mil. The large sizes are quite common in station practice. Between 1,000,000 and 2,000,000 circ.mil standard strand is used where it is more economical than annular or segmental construction. When copper is cheap this is usually the case. When copper is expensive the annular and segmental constructions are usually selected for these sizes, because of their relative economy.

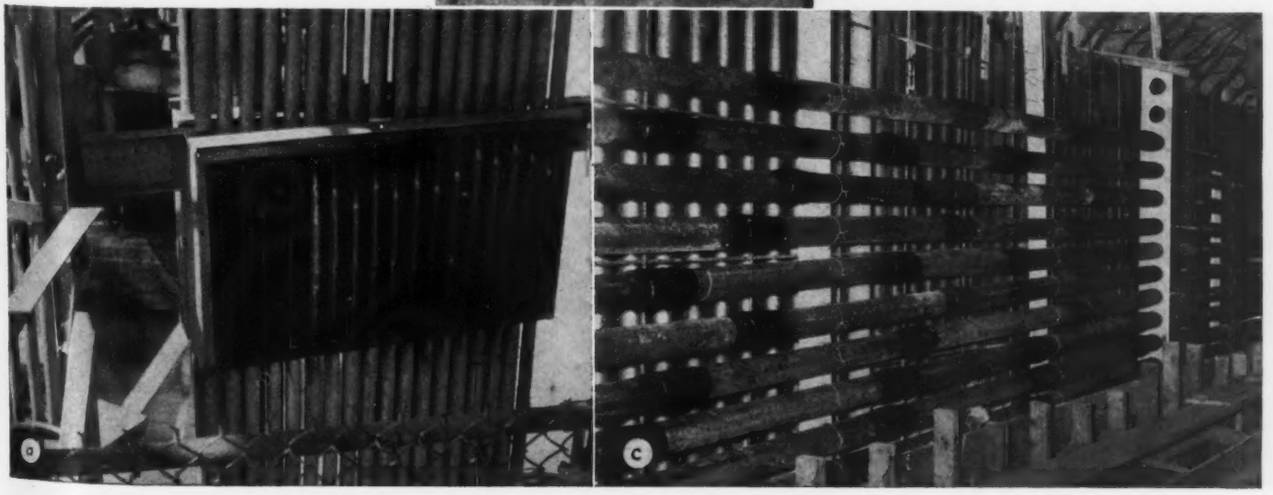
Standard insulations for station cable are paper, varnished cambric and rubber. Paper is ideal for high temperatures and heavy loads because of its high temperature rating (90 deg. C. — E* with a maximum of 85 deg. C.). This type of insulation is generally used for main generator leads and heavy current circuits. It is suitable for all the voltage requirements ordinarily encountered in station cable work.

Paper cable requires a lead sheath or its equivalent. It also requires potheads. Moreover, it is not quite as flexible as cables of other types, and experienced splicers are needed to handle it. For these reasons other types of insulation are often favored where temperature and voltage considerations permit their use.

Varnished cambric cable is very popular for station work. It is more flexible than paper cable and does not require a lead sheath or potheads when used indoors in dry locations. In wet locations indoors and in ducts outdoors a lead sheath is necessary, and potheads must be used for outdoor work. The temperature rating is fairly good, though not as good as paper (75 deg.

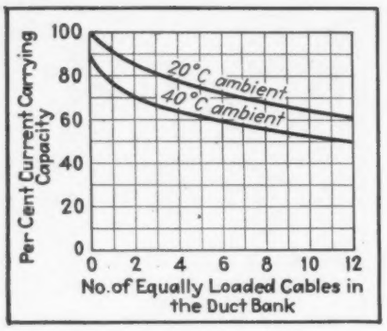


* E represents the (low-voltage) rating of the cable in kilovolts.



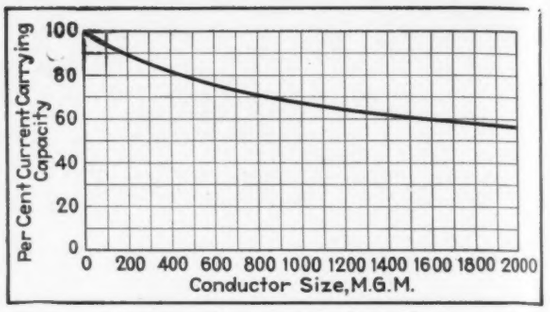
Typical instances of station cable calling for special considerations in cable selection

(a) Characteristic installation of pull-box in metal conduit run of control cables or small three-conductor power leads.
(b) Spreader-type cable entrance at outdoor substation. Construction typical for 25 kv. and above.
(c) Heavy power cable ducts run along station wall ready to be imbedded in concrete.



Congestion reduces carrying capacities

Increasing the ambient temperature from 20 deg. C. to 40 deg. C. here reduces the cable rating by 11 to 19 per cent. Current-carrying capacity may also be reduced (here 45 per cent) by grouping several cables in a single-duct bank.



Short-circuited sheath operation also reduces current-carrying capacity

Open circuit sheath operation advantageous for large cable sizes. Sacrifice can (in the 2,000,000-circ mil size) readily be as much as 48 per cent

C. — E). Varnished cambric can be used up to 15 kv. for three-conductor and up to 26 kv. for single-conductor cables. It is easier to splice and to handle than paper cable.

The new *high-temperature varnished cambric* offers great promise for station applications. Its temperature rating is as high as that of paper (90 deg. C—E with a maximum of 85 deg. C.) up to 7,500 volts. It is intermediate between that of paper and that of ordinary varnished cambric (75 deg. C.) from 7,500 to 15,000 volts. It can thus be used instead of paper for many applications where the load sheath and potheads are objectionable, without material sacrifice in current ratings.

Dry varnished cambric is useful for long vertical risers where various considerations may make rubber cable undesirable, and where compound migration might give trouble on paper or on standard varnished cambric cable. For the lower voltages dry varnished cambric cable is constructed in exactly the same way as the standard varnished cambric cable, except that

[*Continued on page 107*]

Some Special Features to Be Considered in Selecting a Station Cable

1. A transmission or feeder cable is usually an important unit in itself; less frequently it constitutes the major portion of a scheme of underground transmission or distribution. Distribution engineers, therefore, tend to build their distribution systems with the cable as one of the major units. For this reason such considerations as the cost of the cable are matters of utmost importance. In station work, on the other hand, the cable is a minor item. The station is designed primarily around other equipment, such as turbines, generators, transformers and switchgear, and the cable is merely a connecting link between other pieces of apparatus. It must, therefore, fit in with such apparatus and cannot be regarded as an end in itself.

2. This does not mean that a station cable is unimportant. On the contrary, a main station cable is usually far more important than a feeder or network cable. If a feeder or network cable is disabled power can usually be rerouted to take care of the emergency, whereas the loss of a station cable will frequently tie up a major generating unit. It may even tie up an entire station, if the failure spreads to other cables and apparatus. Moreover, the cost of a station cable is usually a minor item in the cost of the entire station. For these reasons, while one should always strive for economy, conservative design is relatively more important in a station cable than on a feeder or a distribution cable.

3. The conditions of installation are usually not so well established in station work as they are in transmission and distribution work. The presence of external sources of heat is much more probable around stations than along feeder cables. Thermal data for grouped conduits in floors, ceilings and walls is very limited and mostly theoretical.

4. Congestion is usually more severe in stations than on feeder lines. Heavy groupings of large cables are common. Heating is frequently a very serious problem, even when there are no external sources of heat. Proximity effect, current balance between cables in parallel, and similar problems, are frequently important considerations. The illustration above at left shows the effect of congestion on cable rating.

5. Large station cables are usually operated with open-circuited sheath. Sheath voltages must usually be considered when laying out such cable systems. A maximum of 12 volts for ordinary station conditions is usually considered about right, although under very dry conditions this value may be exceeded somewhat without undue hazard. On the other hand, where the possibility of corrosion is suspected, this figure may be much too high. The illustration at right shows why open-circuited sheath operation is desirable.

6. Space limitations are often very important, not only in connection with the cable itself but also in connection with the cable termination. It is sometimes impractical to use potheads on account of space limitations.

7. Where station cables are used indoors it is often both desirable and practical to use non-leaded cables, providing conditions around the station are dry and if a suitable type of insulation can be used.

8. Short-circuit stresses often have to be studied and provided for, especially when cables are not installed in ducts. These stresses usually tend to be much higher in the neighborhood of generating stations than at most other points on the system, since a short circuit in the neighborhood of a generating station is usually of greater magnitude than it is elsewhere.

9. When cables are not installed in ducts fireproofing must receive careful consideration. Because of this and because of the problem of short-circuit stresses important station cables, especially those such as large generator leads, are usually installed in conduits in practice.

10. Voltages run anywhere from 110 up to 22,000. Occasionally higher voltages (33,000, 66,000 and 132,000) are encountered in station yards.

11. Regulation is seldom a problem in station cable work, since the cables themselves are usually quite short and since the conductor sizes dictated by heating consideration are almost always adequate to take care of regulation.

12. In addition to external sources of heat, one frequently encounters steel beams and other steel structures around stations which are placed in the neighborhood of cables. If the cables are carrying heavy loads it is often necessary to investigate the heating effect of the cable on such magnetic structures in order to make sure that the temperature of the cable will not be unduly raised thereby. Sometimes such a study is needed to assure that structural members shall not be mechanically weakened by such heating.

13. All the foregoing considerations point to the fact that it is necessary to be conservative in rating station cables. A common practice on generator leads is to recommend sizes which will give calculated temperatures of from 5 to 10 deg. C. below the A.I.E.E. rule. This can usually be done without burdening the installation with excessive cost. This is true because of the relatively small length of cable involved and also because of the fact that it constitutes, as a rule, a very minor portion of the total cost of the station. The station ambient is usually taken as 40 deg. C. in cool or moderate climates, unless more accurate data are available.

Occasionally however, conditions are encountered which make it necessary to go up to the full A.I.E.E. rule. This can be done if it is absolutely necessary, but it is better to play safe whenever it is reasonably possible to do so.

Water Heaters Boost Average Domestic Usage

Long charging period of Maine utility results in large consumption compared to demand

By GEORGE S. WILLIAMS

Vice-President and General Manager Central Maine Power Company, Augusta, Me.

VIGOROUS merchandising of electric storage type water heaters, combined with favorable rates and customers responsive to progressive uses of electricity in the home, has placed 2,475 such heaters on our lines in the past ten years. These have contributed materially to raising our average annual energy consumption per domestic customer from 427 to 650 kw.-hr. Looking at the matter from the standpoint of system capacity, experience shows that the diversity factor in the operation of low-wattage type heaters is about 60 per cent; *i.e.*, the maximum capacity required by a 1,500-watt installation runs about 900 watts each for a group, which cannot be regarded as much of a handicap from a capital viewpoint.

About 1930 we provided a special storage water heating rate and began to make tests of heaters in the home. From the start we believed that the utility needed an appliance which would build load without a large increase in system demand and that the water heater, if built to compete with *available* fuels, would be the answer. This special rate was 1.5 cents per kilowatt-hour, with a monthly minimum of $4 on storage type heaters with insulated tanks, automatic control of temperature, wattage limited to 2,000 per heater 24-hour charging period and no other appliance allowed connected to this meter.

Installations were made according to local plumbing practices and in some cases resulted in heaters being located near furnaces in basements, back of kitchen ranges or in the bathroom on the second floor. In such instances the heater was used to replace the range boiler and was connected direct to the furnace coil and used as an auxiliary type—not as a 24-hour continuous storage heater. In our old New England type rambling homesteads this resulted in long pipe runs to the kitchen sink, with the usual ¾-in. pipe used for hot water lines at that time.

As most of the heaters at this time were sold to such families as would have a large demand for hot water, or in homes with two or more bathrooms, the demand in many instances was excessive or the heater was undersized, so that in order to give service it was found necessary to set the thermostat high or increase the wattage of the elements. With such installations and the 1½-cent rate we found the cost of delivering hot water at the faucet was nearly double what it is today, but it is interesting to note that the efficiency of the new heater is less than 10 per cent higher than that of the heater used. Despite these disadvantages, 180 heaters were sold in the first four or five months.

George S. Williams

The first heaters on which we standardized were of the single-unit type, with the element inclosed in a copper tube immersed in the bottom of the heater. The air in the chamber was heated by an open coil and applied to the water by conduction. The thermostat was about half way up the tank, so that in reality the tank was never full of hot water when the control cut off the heating unit. On the early type of heater there was little effort made to prevent mixing the incoming cold water with the heated water in the tank. The standard unit rating was from 1,500 to 2,500 watts.

Enter the split type unit

After analyzing the results of our tests and watching heaters in service, the question arose whether it would be better to limit operation to off-peak periods, requiring an expensive time switch and load-limiting devices, or to use a smaller unit which would enable the load to be distributed over the entire 24-hour period. Our engineers decided on the split type unit without time-limiting devices. With this type unit the bottom or low-wattage section could

be on at any time, leaving the responsibility for the peak draw-off to the unit in the upper part of the tank. As designed and built to our specifications by an American manufacturer, the heater had the standard 50-gal. tank, the heating elements being split between 500 and 800 watts. Later the upper element was changed to 1,000 watts.

The principle of heating water was the same as with the single bottom unit, except that the split open coil unit was located in the center top of the tank and extended in a copper tube to within six to eight inches of the bottom. With this heater we had quicker recovery on maximum days and a higher over-all efficiency on account of the cold water diffuser which allowed a minimum of mixing of incoming cold water with the hot water in the tank. Even with these changes we were still in the pioneering stage, and many heaters were allowed to be located by the plumber and connected direct to furnace or range coil and use, not as the 24-hour continuous storage heater, but as an auxiliary type which could be turned on or off manually with the demand for hot water.

Improved designs, better rates help

In the 1932-34 depression period heater sales fell off. However, we maintained our interest in locating a new type of heater and in setting up a special water heating rate that would take care of all classes of service and give the company a demand for its output without imposing unnecessary expense upon the company for larger lines and transformers.

Late in 1933 an experimental rate schedule was set up for one section of our territory. The experimental rate schedule was as follows:

Rooms	Kw.-Hr. 1st Step at 10 Cents per Kw.-Hr.	Kw.-Hr. 2d Step at 5 cents per Kw.-Hr.	Excess 2 Cents per Kw.-Hr.
3	15	35	50
4	18	42	60
5	21	49	70
6	24	56	80
7	27	63	90
8	30	70	100

Where a storage type water heater was installed all kilowatt-hours over 200 were billed at 1 cent, all service measured through one meter, on 24-hour service without limitation other than unit specifications of 20 watts per gallon of tank capacity for the bottom unit and 30 watts per gallon of tank capacity for the top unit, and demand-limiting devices required. In other territories the monthly minimum was changed to a yearly minimum of $12 per kilowatt of connected load or, in no case, less than $36 per year.

The heater, approved by our engineers, was of the twin unit type with thermostats located directly over the elements, both at the top and the bottom of the tank. The lower element acted as a service unit and carried a large part of the load, while the upper element operated on a double-throw thermostat and cut in at any time when the draw took over 75 per cent of the tank of heated water. Both units were never allowed to be on at the same time.

With this new heater we standardized on the monel metal tank, which, as far as we know, will withstand any chemical reaction from the water in the territory we serve, our water being corrosive on most metals because of acid content.

Seven-hour off-period

In June, 1935, our first restricted service rate was filed, this rate being similar to the experimental rate used in 1933, except that this rate stated "the operation of the water heater shall be controlled by an automatic time switch which will disconnect the bottom or storage unit of the multiple-unit heater or the unit of a single-unit heater during such period of each day as the company may designate, provided, however, that the total of such periods shall in no case exceed seven hours per day."

With this one meter rate we also had available for either domestic or commercial customers a separate meter restricted service rate of $2 net per month for the first 2,000 watts of connected load, which $2 included the use of 133 kw.-hr.; $1 net for each 1,000 watts of connected load, or fraction thereof in excess of the first 2,000 watts, which $1 includes the use of 66 kw.-hr.; 8 mills per kilowatt-hour for all energy used in excess of the above, with the yearly minimum charge reduced to $30.

The old unrestricted water heating rate is still available on separate meter, no other appliance being connected to it, and the rate is 1.5 cents per kilowatt-hour with restricted capacity and wattage.

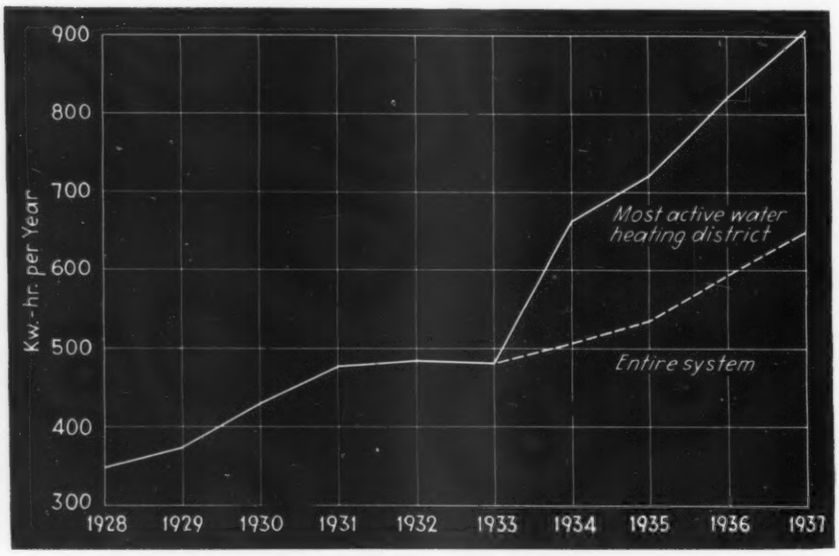
In March, 1937, another rate revision, lowering the steps of the domestic rate, left our water heating rate and specifications about the same. The steps of the rate follow:

	Cents
First 25 Kw.-hr. used in month (20 Kw.-hr. for 5 rooms or less)	8
Next 50 Kw.-hr. used in month (20 Kw.-hr. for 5 rooms or less)	5
Excess Kw.-hr. used in month (20 Kw.-hr. for 5 rooms or less)	2

Where storage electric water heater is used on company's regulations, the rate per kilowatt-hour is 1 cent for all energy used in excess of 200 kw.-hr. per month.

These rates encourage water heater sales. For the average home, with heater properly located and efficient

[*Continued on page 97*]



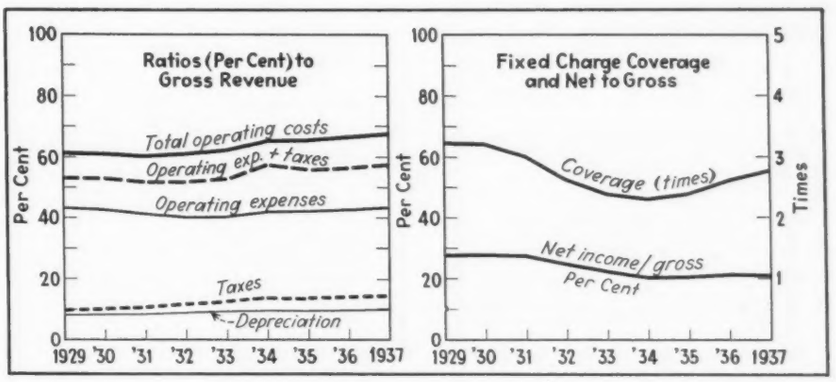
Energy consumption grows faster in districts using relatively more electric water heaters

In the most active water heating district there are 4,865 domestic meters with an average of 1937 usage of 910 kw.-hr. each. This was a gain of 90 kw.-hr. over 1936.

Operating Costs Increasing

Group figures show taxes up 46 % since 1929— Smaller net incomes— Fixed charge coverage increasing

CONTINUOUSLY and rapidly rising tax ratios, larger operating expenses in relation to gross revenue and a definite downward trend in the percentage of net incomes to gross are revealed in the accompanying table. It presents aggregate figures on the operations, over a period of nine years, of a group of electric light and power companies constituting about 85 per cent of the industry; the computed ratios may, therefore, be considered representative of the industry as a whole.



Certain qualifications should be kept in mind. The gross revenues of these companies, as well as the other quantities, necessarily involve some non-electric utility operations. However, it is stated by the compiler, Standard Statistics Company, Inc., that no companies were included in which electric service does not strongly predominate. This dilution does not importantly affect the conclusions to be drawn from the figures. That much is evident from the remarkably close agreement of several of the series of ratios compared with corresponding ratios computed independently and published year by year in ELECTRICAL WORLD.

Gross revenues of these representative companies sagged in 1933 to 87 per cent of their volume in 1929 and subsequently recovered to 104 per cent in 1937. For comparison, the percentages of revenue from ultimate consumers for the entire electric light and power industry, based on E.E.I. statistics, were 90 and 113 respectively. Operating expenses moved in synchronism with revenue. But not taxes. Those have increased annually without a single exception.

Coming now to ratios referred to gross revenue, operating expenses were the same in 1937 as in 1929. They decreased until 1932. Since 1933 they have been increasing.

Taxes took 9.8 per cent in 1929, 14.3 per cent in 1937, a relative increase of 46 per cent. The combined effect, including taxes and somewhat more liberal amounts for depreciation

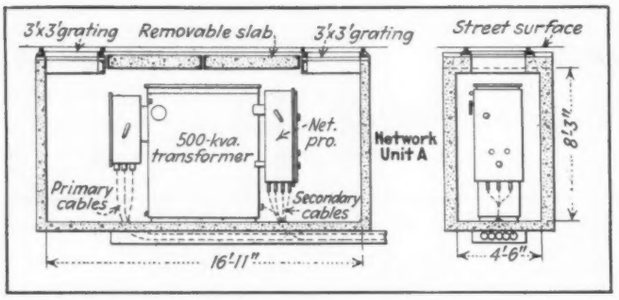
[*Continued on page 108*]

OPERATIONS OF THE ELECTRIC LIGHT AND POWER INDUSTRY

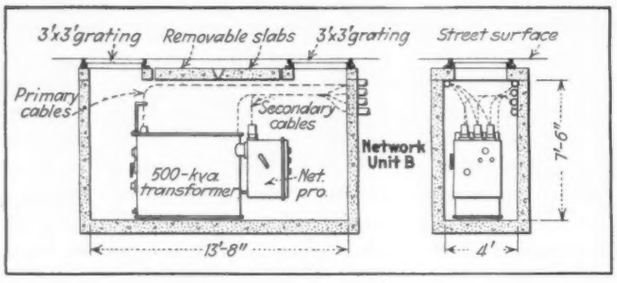
Aggregate Figures on Companies Making Up About 85 Per Cent of the Industry. Compiled by Standard Statistics Company, Inc.

	(In Millions of Dollars)								
	1929	1930	1931	1932	1933	1934	1935	1936	1937 (Est.)
Gross	2,002.6	2,018.3	1,962.9	1,812.6	1,734.2	1,801.9	1,872.8	1,998.3	2 093.5
Operating expense	884.9	881.6	833.2	745.7	716.6	771.9	802.6	870.2	927.4
Depreciation	162.4	162.9	159.7	161.8	162.3	172.8	180.7	193.9	207.2
Taxes	195.6	201.1	205.3	211.7	216.3	239.5	252.1	278.7	300.0
Total operating costs	1,242.9	1,245.6	1,198.2	1,119.2	1,095.2	1,184.2	1,235.4	1,342.8	1,434.6
Operating income	759.7	772.7	764.7	693.4	639.0	617.7	637.4	555.5	658.9
Other income (net)	38.6	38.7	37.9	23.1	16.4	13.0	9.3	15.4	12.6
Total income	798.3	811.4	802.6	716.5	655.4	630.7	646.7	670.9	671.5
Fixed charges	260.4	265.3	280.3	288.0	289.2	286.1	284.6	271.6	258.0
Net income	537.9	546.1	522.3	428.5	366.2	344.6	362.1	399.3	413.5
Operating expenses to gross (%)	44.2	43.7	42.5	41.1	41.3	42.8	42.9	43.6	44.3
Depreciation to gross (%)	8.1	8.1	8.1	8.9	9.4	9.6	9.6	9.7	9.9
Taxes to gross (%)	9.8	10.0	10.5	11.7	12.5	13.3	13.5	13.9	14.3
Total operating to gross (%)	62.1	61.8	61.1	61.9	63.2	65.7	66.0	67.2	68.5
Fixed charge coverage (times)	3.07	3.06	2.86	2.49	2.27	2.20	2.27	2.47	2.60
Net income to gross (%)	26.8	27.1	26.6	23.6	21.1	19.1	19.3	20.0	19.7

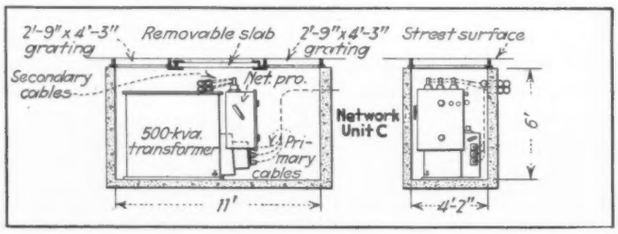
Manhole Units Evolved



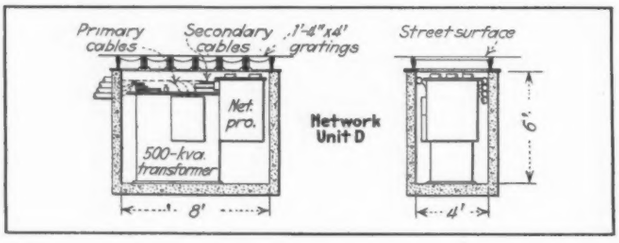
(A) Original 500-kva. network unit required a manhole whose inside dimensions were 16 ft. 11 in.x4 ft. 6 in.x8 ft. 3 in.—This manhole had a removable ventilating and access opening at each end of the hole and had removable concrete slabs, covered with paving over the center section. Subsequent modifications permitted this unit to be used in a 4-ft. wide manhole. This was the conventional normal loss transformer design, having a primary terminal chamber, containing a three-pole, two-position grounding switch on one end of the unit and a network protector bolted to a throat at the opposite end of the unit. The unit was quite tall and the primary and secondary cables were therefore brought out of the bottom of the respective compartments. All the transformer accessories, such as ratio adjuster handle, drain and filter valves, oil gauge, thermometer, pressure test and oil sampling fittings, were located in the vicinity of the primary terminal chamber, while all the accessories associated with the network protector, such as the operating handle, position indicating lamp bullseye, the fuse and operation counter observation windows and pressure test fitting, were located on the protector housing. Working space was required at both ends of the manhole. This design had several disadvantages in that there was very little space to rack, install and maintain the secondary cables under the network protector, there was a relatively large amount of gasket edge surface to maintain, the main tank cover was so close to the roof of the manhole that it was difficult to maintain or replace this gasket and it was difficult to repaint the transformer in the manhole.



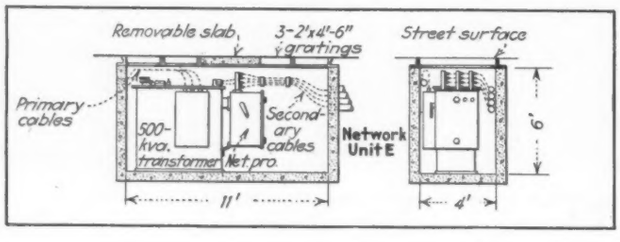
(B) Better design obtained by decreasing the losses of the 500-kva. unit about 18 per cent.—This unit is about two-thirds as tall as design A, has the primary and secondary connections made on top of the unit and has accessories located in about the same position as unit A. Two variations of the primary and secondary connections are possible. A primary terminal and ground switch chamber may be supplied and the primary connection made therein, or the primary connection may be made by a bayonet terminal formed on the end of each single-conductor cable and plugged into suitable receptacles, forming a part of the ground switch unit located in the main tank. This latter design is considered preferable because it eliminates the primary terminal chamber with its additional gaskets and bushings and because the design readily provides phase isolation of the ground switch and primary termination. The secondary connection may be made through a wiping sleeve for each cable in the top of the network protector housing or a bushing may be brought through the housing for each phase and the secondary connections made to a suitable rubberized multiple terminal assembled on top of the bushing. The latter is the preferable arrangement because it permits safer live maintenance operations on the secondary cables. This unit makes the primary and secondary connections more accessible than unit A, reduces the total amount of gasket edge, places most of the gaskets in a position where they can more readily be maintained and facilitates painting in place by providing working space on top of the unit. It requires working space at both ends of the unit and does not materially reduce the volume occupied by the manhole.



(C) Network unit C was designed to reduce materially the manhole volume—It requires normal working space at only one end of the manhole because the primary and secondary connections and all accessories are concentrated at one end of the unit. Entry is provided at the opposite end of the manhole to provide access to the top of the unit for tightening cover bolts and for painting. The secondary connections are made to the top of porcelain bushings on the protector housing cover and the primary connections are of the bayonet type, which are plugged into potheads in a box at the lower right-hand corner of the working end of the unit. The ground switch is in this same box, which, if necessary, can be removed as a unit for maintenance operations on the ground switch. The network protector housing is mounted to the left of the center line of the transformer to permit access to all the transformer accessories which are located to the right of the protector above the primary terminals. This unit does not provide as ready access to the main cover, or facilitate painting in place, as does design B, and it has considerable gasketed surface associated with the primary terminals, which are near the floor and therefore more subject to leaks when water is in the manhole.



(D) Network unit D has all the accessories and cable connections on the cover of the unit with no gasket or fitting of any kind below the cover level—The unit is operated and maintained from the street level, the network protector housing is welded to the transformer and the switch is removed by lifting it vertically out of the housing, which feature has caused it to be termed a "lift-out" type network unit. A 500-kva., 13.8-kv. unit of this type requires a manhole with inside dimensions of only 4 ft. x 8 ft. in floor space and 6 ft. minimum headroom. The entire cover consists of grating sections which can be removed conveniently for installation and maintenance operations. Three accompanying illustrations show the manhole cover (Fig. 2), the unit installed in the manhole (Fig. 3) and the protector lifted out for a maintenance operation (Fig. 4).



(E) Network unit E is a combination of the "lift-out" type transformer with the conventionally mounted network protector installed in a manhole having a completely removable roof section—It provides all the advantages of transformer installation maintenance which were stated for network unit D, but permits protector maintenance to be performed in the working space at one end of the manhole.

Fig. 1—Network installation progressively reduced 8 per cent in cost

to Lower Cost Installed

Network vault dimensions reduced, accessibility retained, joint leakage minimized, connections simplified, ventilation increased

By THEODORE D. REIMERS
Consolidated Edison Company of New York, Inc.

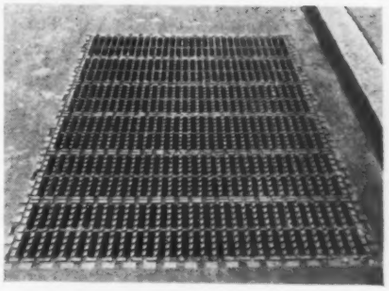


Fig. 2—Manhole grating 4x8 ft. for 500-kva. "lift-out" unit

IN THE past six years several designs of three-phase submersible network units have been evolved which are worthy of comparison. Each successive change resulted in the manufacture of a unit that could be used in a smaller manhole and that facilitated installation and maintenance operations. Small transformer manholes are particularly desirable in the more developed sections of large cities where the area under the roadway is occupied by electric, telephone and telegraph conduit system, by gas, water, steam and sewer main and by transit systems, and where it is, therefore, difficult to find suitable space for transformer units. This comparison is based on 500-kva., 13- or 27-kv. network units, but it is believed that approximately the same relations would exist for units of other capacity and voltage rating.

It is of interest to describe one of the latest units in some detail because of the novel design features which make the operation of this unit practical. In designing this unit (D) every attempt was made to reduce the amount of gasket edge surface to a minimum.

The transformer part of the unit has the grounding switch and primary connection in a box welded to the side of the unit. This box is directly open to the main tank. The three-pole, two-position grounding switch and primary connection receptacle is mounted in the box from

[*Continued on page 104*]

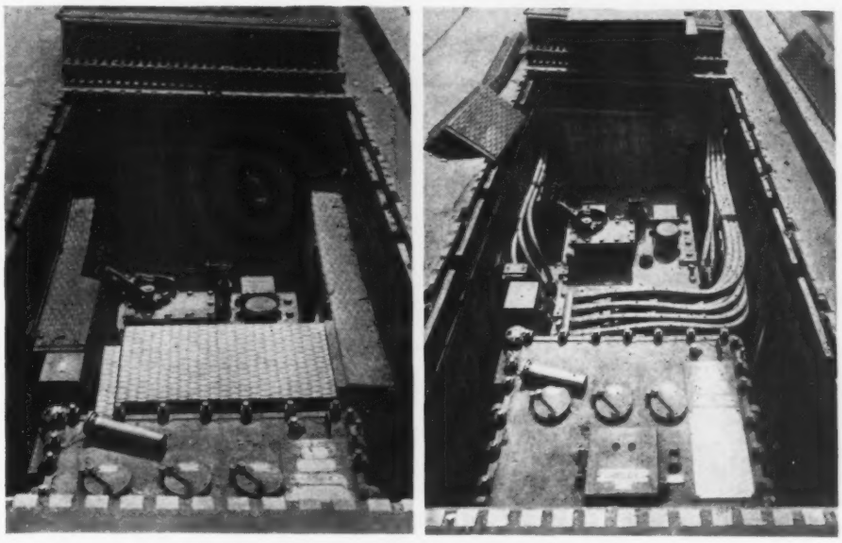


Fig. 3—500-kva. network installation
Left—Cable covers in place for protection. Right—Cable covers removed

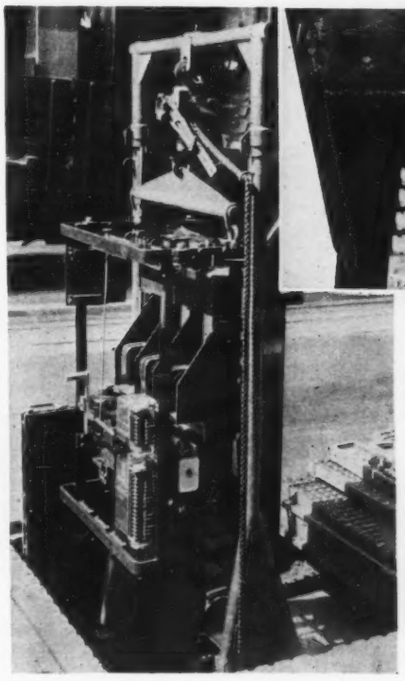


Fig. 4—"Pull lift" raises network protector to "lift-out" position for maintenance

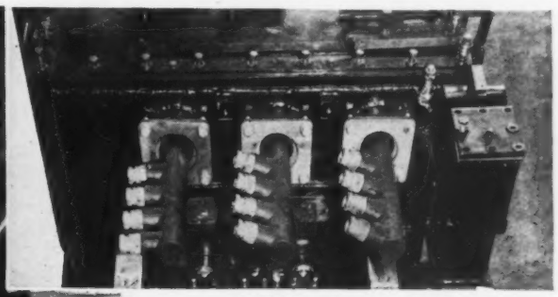


Fig. 5—Multiple connector is also entrance bushing

It consists of a hexagonal rod to which are fastened four mechanical connectors for 500,000-circ.mil cable and to which a flange plate has been attached at the point where it will be clamped to the housing. The inner end of the rod is threaded to receive a connector within the housing and the whole terminal assembly except the end of the mechanical connectors and the threaded end of the rod is covered with ¼ in. of rubber applied in a suitable mold. The rubberized flange is directly clamped within a clamping ring which entirely retains the flange. The secondary cables are connected to the solderless connectors and a rubber tape seal applied from the rubberized terminal to the insulation on each cable.

Buyer's Factory Inspection of Cable Not Worth Cost

Limited inspection on receipt is amply justified—
Occasional factory inspection appears very advisable for psychological effect

By OTHO B. TURBYFILL
Engineering Department, Commonwealth Edison Company, Chicago

CHANGED economic and technical conditions relating to electric power cable have caused a need for evaluation of the benefits of factory inspection of underground cable by independent agencies. A study made in the Commonwealth Edison Company shows that under present conditions the cost of such inspection is more than its direct value; that is, the capitalized cost of failures assumed to have been prevented by it plus the capitalized cost of energy loss which is possible from decreased copper in the conductor if judged only by routine resistance measurements.

Alternatives canvassed

This conclusion is based on the cost of independent inspection at the factory plus the 2 per cent discount which is forfeited by customer's inspection. The cost of factory inspection and its comparative value, as determined from the records of the Commonwealth Edison Company, appear in the accompanying Figs. 1 and 4.

Alternatives to factory inspection are to:

(a) Continue inspection at the factory, but by employees of the buyer instead of by an independent laboratory.

(b) Omit factory inspection, accepting in lieu the manufacturer's certified reports of tests and measurements made by him, but make a limited number of check tests and a somewhat curtailed inspection of the cable on delivery. This is the procedure adopted by the company in 1936 for cables rated at 17 kv. and less, which is estimated to have resulted in a saving of about $13,000 in the cost of cable inspection during 1937.

(c) Omit inspection both at the factory and on delivery, accepting the manufacturer's certified reports of his tests and measurements.

A detailed comparison made in 1933 showed that procedure (a) would be little if any cheaper than the previous procedure and would have some undesirable aspects. The estimated costs using procedure (b) are shown in Fig. 2. This procedure would save the 2 per cent discount for omitting inspection at the factory as well as part of the direct cost of inspection, but would not be as effective as (a). Procedure (c) would, of course, eliminate the entire cost of inspection.

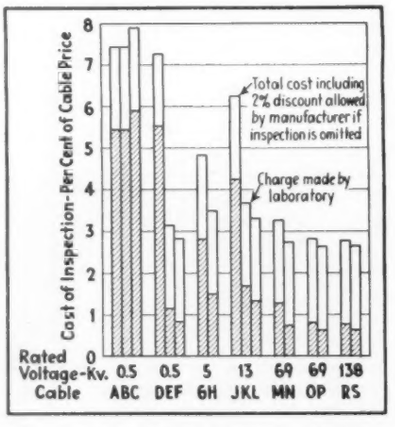


Fig. 1—Cost of factory inspection
This graph shows total costs of inspection made by an independent laboratory at the factory of new underground cable of all types purchased by Commonwealth Edison Company.

Fig. 2—Inspection on delivery
Here are the estimated costs of limited inspection on delivery in Chicago made in lieu of inspection at the factory.

Value of inspection

The principal benefits derived from inspection are:

(a) Lower rates of failure or other troubles in service.

(b) Higher average area of conductors resulting in lower energy losses in the conductor.

(c) The psychological effect on the manufacturer.

In order to determine the saving effected by inspection in the rates of failures and other troubles in service, it was first necessary to determine the kind and frequency of defects in cable which were revealed by the tests and inspection at the factory. Fig. 3 gives a summary of the cable inspected in the period from January 1, 1934, to October 1, 1936. The amounts of cable found to contain various types of defects are shown as percentages of the total footage of cable inspected. Also, the defects found as a result of the tests conducted by the manufacturer are shown separately from those found as a result of the examination and measurements made by the inspector. Only the latter would be immediately affected by the omission of inspection.

Fig. 3 shows that no serious defects in the 500-volt rubber-insulated cable were found by the inspector. In addition, experience has shown that failures in this type of cable are almost always due to external damages rather than inherent defects. It appears, therefore, that the omission of inspection on this cable would have little or no effect on the rates of failures or other troubles in service.

Conductors designed to meet resistance stipulations

For the impregnated paper-insulated cables of all voltages, however, an average of 1.38 per cent was found to be seriously defective by the inspector. Experience in Chicago has shown that such serious defects are more likely to result in failures or other troubles in service for the higher voltage cables.

The estimated percentages of the seriously defective cables which would eventually result in troubles in service are as follows:

0.5-kv. cables, per cent	30
5-kv. cables, per cent	50
13 to 17-kv. cables, per cent	75
69-kv. cables, per cent	90

Based on these figures the capitalized cost of the additional failures which would occur if inspection were omitted are shown in Fig. 4 as a percentage of the cable price.

Past experience has shown that manufacturers in general tend to design their conductors so as to meet the requirement on conductor resistance rather than to obtain a conductor cross-sectional area equal to that specified by the purchaser. This is particularly true of conductors containing deformed strands, such as sector or "compack" conductors, for which an accurate measurement of conductor area is difficult. Due to the high conductivity of most commercial copper as well as the use of special conductor designs it is possible in most cases to obtain the specified conductor resistance with a copper area 1.5 to 2.0 per cent lower than the specified area. It seems safe to assume, therefore, that, if inspection and hence the periodic measurement of copper area were omitted, the average conductor area obtained would be 1 per cent or more below that obtained at present. This is corroborated by the fact that numerous cases of subnormal conductor area have been found in the past in

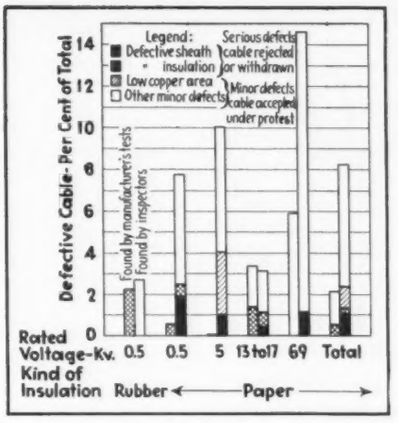

Legend:
Defective sheath
Insulation
Low copper area
Other minor defects
Serious defects cable rejected or withdrawn
Minor defects cable accepted under protest
Defective Cable-Per Cent of Total
Found by manufacturer's tests
Found by inspectors
Rated Voltage-Kv. 0.5 0.5 5 13 to 17 69 Total
Kind of Insulation Rubber ← Paper →

Fig. 3—Defects found by factory inspection

This is a record of defective power cable in Commonwealth Edison purchases uncovered by factory inspection in the period from January 1, 1934, to October 1, 1936.

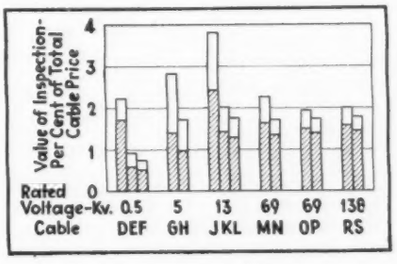


Fig. 4—Direct value of elimination of cable defects

The cross-hatched areas indicate the estimated capitalized cost of failures which would have occurred if cable found defective had been installed and the open areas the estimated capitalized cost of increase in energy loss due to decreased sectional conductor area if judged only by resistance measurements.

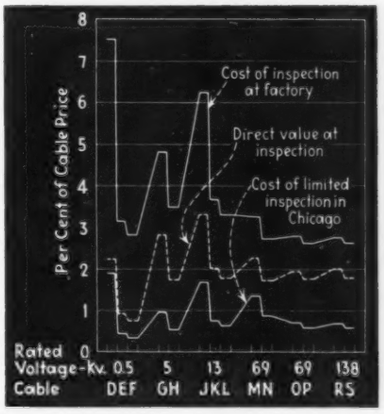

Per Cent of Cable Price
Cost of inspection at factory
Direct value at inspection
Cost of limited inspection in Chicago
Rated Voltage-Kv. 0.5 5 13 69 69 138
Cable DEF GH JKL MN OP RS

Fig. 5—Comparison of cost and value of inspection

cables which had normal conductor resistance.

Based on the assumption that a decrease of 1 per cent would occur if inspection were omitted, the capitalized costs of the increased energy losses in the conductor which would result are shown in Fig. 4. These values are based on a cost for energy of 0.6 cent per kilowatt-hour.

Psychological effect retained

The psychological effect of inspection on the manufacturer is one of the most valuable and important aspects of cable inspection. It is, however, unfortunately of such an indefinite nature that its exact monetary value cannot be readily determined. It is probable that if all inspection were eliminated now no appreciable effect in the quality of cable would become apparent for several years. The history of industry shows, however, that inspection by the purchaser has the general effect of detecting defects and of instituting improvements in manufacture.

For the cable industry inspection by the purchaser constitutes the only means of detecting many types of defects and impressing upon the manufacturer the necessity for eliminating them. An outstanding example of this is the recent pronounced improvements shown in lead sheaths.

One of the most effective means of impressing upon the manufacturers the necessity for this improvement was the adoption of a simple test to be made upon the sheath by the inspector at the factory and also, in some cases, on samples of sheath obtained from the cable during installation. Since the application of this test depended to a considerable extent upon the personal judgment of the inspector, it is obvious that reliable information could not have been obtained from a similar test made and reported by the manufacturer.

Protests lead to better cable

The importance of this psychological effect is indicated clearly by Fig. 3. The final column shows that, in addition to the cables found to be seriously defective, the purchaser's inspector found minor defects in 6.74 per cent of all cable inspected. These defects were not considered to be sufficiently serious to warrant rejection of the cable involved, but it was accepted only under protest. Experience shows that such protests have a direct beneficial effect toward better made cable.

Editorials

S. B. WILLIAMS, Editor

The First Five Years of Better Light-Better Sight

THIS YEAR the Better Light-Better Sight movement will be five years old. And congratulations are in order, for this depression-born activity has been the most successful and significant co-operative effort of the electrical industry.

Better Light-Better Sight has completely changed the practice of selling lighting. It has placed the emphasis on vision—on seeing, and thereby has given the purchaser a new concept of the value of light and more light.

In order to convince the public of the value of better light and more light, new selling tools were developed, not the least of which was the light meter. And around these tools has been built a new technique in selling whereby the customer benefits have been studied and presented in an easily understood manner.

There also has come a new design of lighting equipment to give the customer these desired higher lighting values without discomfort or without the light being too obvious. The I.E.S. lamp was born of the movement and is rapidly altering the whole scheme of residential lighting. Store lighting through new fixtures is definitely affecting not only merchandise sales but store design as well. The new technique of lighting as applied to schools is improving the scholastic standing of pupils and speeding up their progress. And one could carry this on indefinitely through office buildings, factories, streets, etc., to show that when lighting was promoted as something not to compete with darkness, but to build up vision, it took on brand new sales values that the public was not slow to accept.

To the utility industry Better Light-Better Sight has been of inestimable value because it took lighting out of the bracket of things accepted, and therefore largely forgotten, and placed it in the category of things to be promoted. The utilities started with light as the only load, and though other things began to take more and more sales attention, lighting has always been one of the most important and most profitable loads. And now, with attention once more focused on lighting, it is again demonstrating its ability to absorb kilowatt-hours and at profitable rates.

Prior to Better Light-Better Sight lighting had no glamor—at least not the same sales appeal as some of the large appliances. The co-operative movement gave it the necessary appeal and the industry has gone to town with it.

However, great as the progress has been during these first five years, it is nothing compared to what can and will be done with lighting. We have as yet only scratched the surface. New illuminants, higher wattage and higher intensities, new equipments and constantly increasing selling pressure, as utilities appreciate the sales possibilities and low selling costs, will bring many times greater results in the second five years of Better Light-Better Sight.

•

The Public Likes Industrial Sound Pictures

NEARLY three hundred thousand people saw the New Jersey Public Service's sound film "A Cycle of Service" in its first two years. It was exhibited, free of charge, 1,765 times and has proved so popular that a new one is being made, to be ready this spring.

Other utilities have built sound films showing how their operations affect the daily life of the communities they serve and this means of reaching the public has proved to be very effective. The public has been found to be intensely interested in pictures of industry. Picture houses have sensed this and are asking for more good films of that kind. In the preparation of the films, however, care must be taken not to engage in direct selling. This appears to be true whether the film is to create better public relations or to assist in merchandising appliances.

There is an opportunity here for more utilities to tell their story of service to the public—not with a nationally released picture, but one locally shot with local people whom the home folks know. The whole community cannot be taken through the generating plant, substations and out on the lines, but by means of sound pictures the system can be brought to pretty nearly the entire customer list—especially in the smaller cities.

•

"New Device to Cut Bills for Lighting"

VOLTA must have stirred in his grave at the latest fantastic perversions coming from the Washington propaganda machine. "Designed to save the American people thousands of dollars on their electric light bills a group of Bureau of Standards said" is the way the news announced the new absolute electrometer perfected by the electrical division after a decade of inter-

mittent effort. Anybody who knows Drs. Brooks, Defandorf and Silsbee, who built the machine, would insist that their scientific integrity would never sanction such fantastic distortion of their accomplishment.

Not enough to credit American science with the first practical equipment for weighing the elusive by means of a beam balance. Not enough to laud the persistent research which extends high-voltage measurement into a range where the sphere gap left doubts. Not enough to reconfirm the official Bureau of Standards as the final arbiter on electrical precision.

No, science must be prostituted to an obsession. Utility patrons must be given steady doses of distrust of their suppliers, even though every electrical man knows that accuracy in extremely high-voltage measurements has no bearing whatever on the price folks pay for electricity. If any dollars of the American people are involved, they rest in the justified outlay for the electrometer and in the utterly unjustified wages of the pernicious brood of propagandists that infest Washington trying to infect the gullible.

•

Light on Night Accidents

THE traffic problem, with its casualty lists comparable to the toll of modern warfare, is now showing definite response to progressive methods of control.

For some months we have been hearing about the remarkable improvement in safety which has been realized in Detroit through new street lighting. Now another Great Lakes city, Cleveland, has produced very substantial results in a drive against traffic accidents. The details of these two interesting programs are notable in their difference of method and the way they point to the chief traffic hazard, night.

During the first eight weeks of 1938 traffic deaths in Cleveland were held to 17, as against 40 for the same period in 1937. But of the 17 deaths in 1938 all but one occurred at night. The abnormally high number of night fatalities confirms the experience of Detroit, where, over a period of five years, it was found that methods which had proved definitely successful in lowering the number of day fatalities had not been able to stop the mounting trend of night fatalities. In the preceding three years under mediocre lighting night fatalities had been seven times those by day.

In an experimental program involving the most hazardous thoroughfares new street lighting in Detroit has reduced the ratio of night to day fatalities from 7 to 1 to 1.6 to 1. At the end of an eight weeks' sustained drive in Cleveland night fatalities relate to day fatalities in a ratio of 16 to 1.

For a long time it has been known that the chief obstacle to progress in the national concern for traffic safety is darkness, or poor visibility, and that the best way to combat the special traffic hazard of darkness is by adequate street lighting. Although we have known the chief cause and the best remedy we have made no great progress. Many factors have contributed to complicate the problem, and the potency of street lighting has not compared with our moral insistence that we must first become conscientious drivers. We have passed a lot of laws and we have developed a special department of police work to see that the laws are enforced. All this has helped, but we have been singularly diffident about doing the thing that cries most loudly to be done.

At the end of eight weeks' special drive, with school and press co-operating, Cleveland has almost eliminated day traffic fatalities. But night fatalities at this point are sixteen times the day rate.

Is any further evidence needed that night-driving accidents are directly in relation to poor visibility?

•

Corrosion of High-Temperature Piping

IN A recent discussion before the American Society of Mechanical Engineers dealing with the effect of high-temperature steam upon steel piping, pressure alone was shown to have little effect upon the dissociation of steam and the resultant oxidation or corrosion of the piping. Temperature is the controlling factor in this phenomenon, with pressure having a secondary effect of importance. Some of the rates of corrosion given in the discussion would indicate a relatively short life for such piping as superheater tubes when used at these temperatures.

However, one should not draw too definite conclusions from these tests. It is possible that the corrosion effect slows down with time. This is the case with creep phenomenon where the early rate is not sustained after a certain amount of strain has occurred. There is also the possibility of the oxide layer inside the pipe forming a protective coating to the remaining metal, although the difficulty with this protection is that temperature changes in the material, together with any creep present, will continually crack the oxide coating and thus present fresh metal surfaces to attack.

Now that this dissociation and oxidation are established facts, our metallurgists might consider the development of an inhibiting coating for the piping similar to the calorized surfaces used in other branches of industry. An inhibiting constituent may even be incorporated in the composition of the steel itself. This opens a new field for research in metals.

Since a promising field for further economies in power generation by steam lies in the direction of higher steam temperatures, this consideration should give added impetus to further studies of metals for use with high-temperature steam.

Political Boards Not Constructive

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting, even though all may not agree with him

DR. ARTHUR E. MORGAN missed the boat on TVA. He didn't miss it when he refused to let President Roosevelt make the threatened congressional investigation an anti-climax. He missed it when he picked David E Lilienthal and Harcourt A. Morgan as the two other board members. He had *carte blanche*, within reasonable limits, from President Roosevelt to pick his associates.

He thought he was selecting two men who agreed with him, naturally. But he didn't make sure the men he was choosing would be rubberstamps, and that is where he made his big mistake. For Dr. Morgan has his weaknesses. One of them is an extraordinary faith in human nature, and a singular ignorance, not only of politics, but of a symbol which is almost a trademark of that calling, the double cross.

Facts not convincing

It would never have crossed his mind, when he was studying the qualifications of half a dozen candidates he had under consideration, that a simple statement of fact would not be convincing to his proposed colleagues. Having an engineering mind, facts are facts to Dr. Morgan. He had never studied the ramifications of politics or the history of other politically appointed boards.

In that last phrase is the answer to most of the trouble in TVA. There may be an example of where some politically appointed board has successfully carried out a constructive function, but a hurried search through the archives in the last few weeks has failed to disclose it. Judicial functions, investigating functions, yes. Constructive business functions, no. A thousand times no!

Gen. George Goethals, of Panama Canal fame, nearly lost his hard-won reputation when he became chairman of the U. S. Shipping Board, during the war. Thanks to Theodore Roosevelt, who cut the red tape and made Goethals a dictator, he did a marvelous job at Panama. But on the Shipping Board, with William Denman insisting on building wooden ships and other members insisting on this or that, he made what his best friends have always admitted was an absolute flop.

This is no criticism of Goethals. Investigators later conceded that his ideas had been sound, that *if* he could have been the Shipping Administrator, with no fellow board members to bother him, he would probably have done a swell job. But he was just one member, even though the chairman of a politically appointed board. His comment: "All boards are long, narrow and wooden." He should have said "politically appointed boards."

Now comes Dr. Arthur E. Morgan, who did a magnificent job on the Miami Conservancy District, and is being called, by his critics, a carping, meddlesome, publicity-seeking and cantankerous old so and so on TVA.

If the taxpayers of the U. S. would just study this situation, and others like it which dot our political history, and draw the obvious lesson, it might be that even TVA would be worth what it cost.

But corporations perform constructive functions, it may be said, and they are run by boards. Perhaps the chief difference lies in the fact that, in an ordinary corporation, the directors do not all have equal influence. They have one vote each, as in politically appointed boards, but that is only technical. Actually, in 99 cases out of a hundred, one man dominates that board. It may be the president of the company. In such cases he conducts the enterprise, makes the important decisions, and reports to the board. So long as he makes a success, so long as the dividends are being earned and everybody is pleased with the progress being made, he remains dictator. No minority member of the board is allowed to bother him, to force changes, to switch policies. He is not even allowed to talk about such things very much. The other directors are busy. Sometimes the chairman of the board is the real boss. The president or manager is an executive under him.

Business men want success

The point really is that every director is interested primarily in the success of the corporation. He is a stockholder himself, probably a large one. He does not want to mess the thing up. He does not want to let any other director mess it up.

Moreover, the board members are not equal in their power as stockholders. Certain directors will be known as large holders, others as small. Some will be known to represent powerful groups of stockholders. The chief interest of the stockholders is to make money, and they will back the man—one man usually—in whom they have confidence. The troublemaker gets kicked out.

When other elements enter, such as family jealousies, or any other motive stronger than the profit motive, that corporation is usually headed for trouble.

This difference between politically appointed boards and corpora-

[*Continued on page 101*]

News OF THE WEEK

Morgan Removed as TVA Head; Move Stirs Congressional Inquiry

Roosevelt sends message to Congress outlining basis for dismissal — Appoints Harcourt A. Morgan as new TVA head — Gilbertsville Dam appropriation is held up as rebellion in both houses gains momentum

President Roosevelt dismissed Dr. Arthur E. Morgan this week as chairman and director of the Tennessee Valley Authority, effective as of last Wednesday. At the same time Harcourt A. Morgan was appointed new chairman.

Agitated over the refusal of the TVA chairman to take part in his private inquiry and present proof of charges against his fellow directors, Mr. Roosevelt sent a special message to Congress outlining his reasons for Dr. Morgan's dismissal and presented an opinion of acting Attorney-General Robert H. Jackson upholding his right to dismiss any member of the TVA board for cause.

Mr. Roosevelt pointed out in his message that there could be no objection to a congressional investigation of TVA, as sought by Dr. Morgan. He pointed out that he could not in the meanwhile abdicate his constitutional duty to take care that the laws be faithfully executed.

The actions of Mr. Roosevelt in removing Dr. Morgan stirred a wave of rebellion in Congress, with Senator Bridges demanding immediate action on a resolution for a TVA inquiry. He charged President Roosevelt's action as "arbitrary" and "one of the most dictatorial methods ever used." Senator Bridges described the incident as another "Dreyfus case."

In the House a $2,613,000 appropriation for a TVA dam at Gilbertsville, Ky., was turned down. Members of the House were indignant over Dr. Morgan's removal and hurled sharp criticisms.

The feud between the TVA directors has been brewing for more than two years, and it was not until this year that Dr. Morgan brought it to a head by demanding public action and an investigation of TVA operations. It was the marble claims of Senator George L. Berry which provided the outlet.

Letters to Dr. Morgan follows:

The President's letter

DEAR DR. MORGAN:

As a result of the hearings had before me on March 11, 18 and 21, 1938, I regret to inform you that I feel obliged to remove, and do hereby remove, you as member and chairman of the board of the Tennessee Valley Authority. This removal is to become effective as and from March 23, 1938.

As is more fully explained in the memorandum opinion which I read at the hearing on March 21, and by the record before me, I have been impelled to remove you for the following reasons:

(a) Openly making grave and libelous charges of dishonesty and want of integrity against your fellow-directors without reasonable excuse or justification.

(b) Obstructing the work of the Tennessee Valley Authority.

(c) Refusing to submit to the demand of the Chief Executive for facts upon which you relied in openly making grave and libelous charges of dishonesty and want of integrity against your fellow-directors and refusing to respond to questions of the Chief Executive relating to charges of obstruction made against you by your fellow-directors.

I have taken note of the fact that you have not presented to me in person or in writing any reason why I should not remove you other than the statement recorded in the transcript of the proceedings before me on March 21, 1938.

A duplicate of this letter is being filed with the Secretary of State.

Yours respectfully,
FRANKLIN D. ROOSEVELT.

At the second White House conference, Friday a week ago, Chairman Morgan again refused to become a party to the President's private inquiry. Stymied in his proceedings, Mr. Roosevelt said that as the records stand Chairman Morgan has refused to support his charges and that he is guilty of contumacy.

The President then gave Dr. Morgan until Monday of this week for a "yes" or "no" answer as to whether he would present supporting evidence to his charges against his co-directors of "dishonesty, lack of integrity and malfeasance in office."

President Roosevelt explained that he was proceeding under authority as Chief Executive and held that the TVA was under the executive branch of the government. Dr. Morgan challenged the authority of the President's investigating powers and reiterated that the proper group to make an inquiry is Congress.

Dr. Morgan made it plain that he believed that the only way to proceed is through a congressional committee, which would have power to subpoena records, documents and witnesses. In this way, he said, all the relevant facts on the matters can be brought out. He assured Mr. Roosevelt that such was in the interest of TVA.

At the third, or Monday, conference this week, Dr. Morgan reiterated his stand and refused to take part in the President's inquiry. He said that upon consideration he was impelled to say that he could not participate further in the proceedings.

Mr. Roosevelt, after a long discussion of the case, gave Chairman Morgan until last Tuesday to produce evidence to support his charges or retract his statements against his co-directors, cooperate in the future to carry out the provisions of the TVA Act or resign.

The President told Chairman Morgan that "in the light of the record only two courses appear open—either your removal or your suspension as a member of the board of the Tennessee Valley Authority."

Chairman Morgan replied:

"Mr. President, I deny the accuracy and the adequacy and representativeness of the statement you made. I

have no other statements to make here now except these: It is my judgment that my resignation at this time would not be in the public interest. Therefore, I do not tender my resignation. I wish also to say that I challenge the suggestion and deny the right and the power to remove or to suspend me."

After leaving the White House Chairman Morgan summed up his attitude by saying that "I do not choose to run away."

Dr. Morgan was swamped with telegrame lauding his stand. "Stick by your guns. Honesty and decency demand it," a telegram from New Jersey said. "Honesty is still living, you are showing real American spirit," came one from Iowa. "The country is with you," wired a Philadelphian. One from Connecticut said: "Fight, sir, fight. We are all for you, heart and soul."

Mr. Roosevelt supported his stand by asserting that "there is a limit to patience. A recalcitrant, non-co-operative official" should not be allowed freedom "to sabotage government operations." The President also stated that a precedent must not be established whereby any subordinate in the executive branch of the government can refuse to give to his superior or to the Chief Executive himself facts sought in order to straighten out difficulties which he charges exist in his own departmental work.

Carlisle Visions Prosperity Era When Government Restores Faith

Settlement of TVA situation, power policy and repeal of undistributed profits tax seen as necessary to gain public confidence in future — Change would benefit utilities — Johnson elected a trustee

American industry will experience a new era of prosperity when the federal government rests the peace of mind of the people, settles the TVA situation, formulates its national power policy and relieves business from the burden of the undistributed profits tax, Floyd L. Carlisle, chairman of Consolidated Edison Company of New York, Inc., told stockholders at the annual meeting this week.

Mr. Carlisle said that the United States is too big and its people too intelligent to allow the capitalistic system to "go to pot." He said that "things can be done and will be done to correct the present abnormal situation. Great benefits would come if Congress would repeal the surtax on undistributed profits."

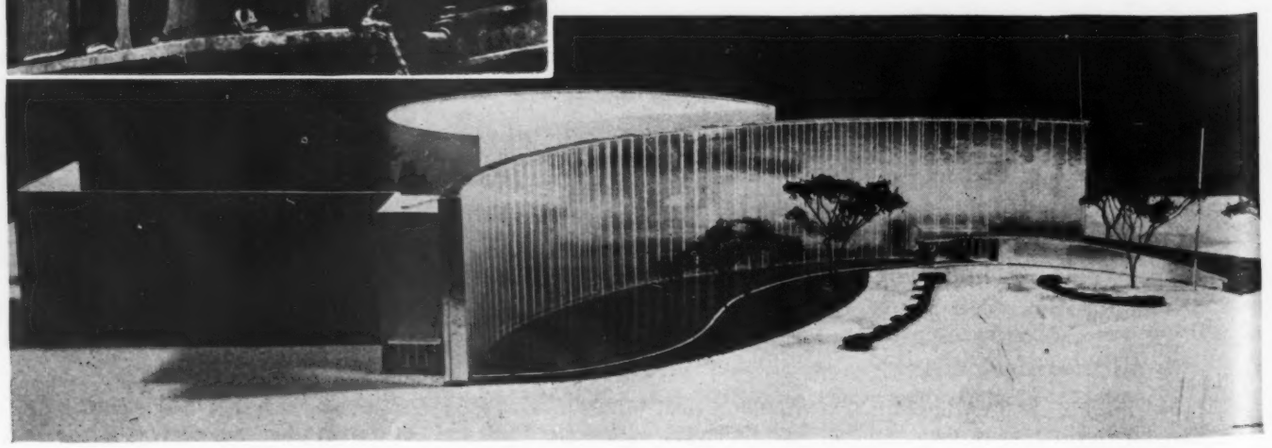
Discussing the 1938 financing plans, Mr. Carlisle stated that the system expects to spend approximately $45,000,000 this year on capital additions, of which $20,000,000 to $30,000,000 must be met by raising new capital. Should the TVA question be settled and the Federal power policy be formulated, Mr. Carlisle said, it would put to rest the people's mind and restore confidence in utility stocks. If this could be done, he said, it would be a very small thing for the markets in public utility stocks to rise to a point which would permit Consolidated Edison to offer common stock.

Mr. Carlisle pointed out that new equity money must be raised by the utilities to meet the demand for service and to prevent a top-heavy debt structure. He said that nothing would help the company more than to be able to sell $25,000,000 of common stock. He indicated that a fair price for the stock would be about $50 a share. It is now selling around $20 a share.

Stockholders authorized the increase of 2,000,000 additional shares of common stock, approved the guarantee up to $10,000,000 aggregate principal amount of bonds or debentures to be issued by Yonkers Electric Light & Power Company, guaranteed up to $32,000,000 aggregate amount of bonds or debentures to be issued by New York Steam Corporation, elected David C. Johnson, vice-president of Consolidated Edison and president of New York Steam, a trustee to fill the vacancy on the board caused by the death of James H. Post, and re-elected all other trustees.

Mr. Carlisle told stockholders that earnings so far this year are better than for the same 1937 period.

BREAKING GROUND— Floyd L. Carlisle, chairman of Consolidated Edison of New York, at the controls of the steam shovel, breaking ground for the utility's building at the New York World's Fair. Grover A. Whalen, chairman of the fair, supervising the job. Bottom is artist's drawing of the building



Connecticut Light & Power Sales of Appliances Reach New High

Company sells 8,679 major appliances having a value of over $1,750,000 during year — Plans to continue installment terms and to promote combination sales and kitchen planning

Sales of electrical appliances last year registered a new high for Connecticut Light & Power Company, with wide acceptance shown for major household units. During the year a total of 8,679 major electrical appliances with a value of more than $1,750,000 were sold.

Outstanding among the major appliances placed in customers' homes were 5,744 electric refrigerators, 1,876 electric ranges and 1,059 electric water heaters. In addition there was marketed a total of 2,074 washers, ironers and cleaners.

Continue installment terms

The company stated that the same installment terms that have contributed notably to its sales results during the last three years will be continued, subject to modification in keeping with present-day trends. It was pointed out that revisions made last year in the company's range wiring allowance are being carried somewhat further this year, to the end that the original allowance will be reduced by approximately one-half.

Coming in for special attention will be combination sales of two or more appliances to be installed at one time. The utility will also continue its promotion of kitchen planning.

Electric construction program for 1938 calls for an expenditure of approximately $2,500,000. About $2,000,000 of this amount will be spent on the usual program of extending, and further improvement of, the electric system, through the extension of transmission lines and 27,800-volt supply lines, the enlargement of substations, and particularly the building of rural electric lines.

Serves 78% of farms

At present the company is serving 78 per cent of the farms in its territory. During the past year 235 miles of rural electric lines were built, making a total of more than 1,500 miles of such lines constructed during the past ten years. This year greater emphasis is being placed on rural line extensions and it is anticipated that more miles of lines will be constructed this year than were put up in 1937.

During 1937 more than $4,000,000 was expended by the company for electric construction purposes. Part of this defrayed a substantial portion of the cost of the company's new 25,000-kw. steam-generating unit at Montville, completed late in the year, and rebuilding the new Scotland Dam station of 2,000 kw., which had been damaged by the 1936 flood.

This year expenditures will go for erecting an office and service building at Essex, Conn., completing major extensions to the company's transmission system and increasing the capacity of the Baldwin Street substation at Waterbury.

•

Indiana Unit Severs Ties With State Rural Board

Directors of the Henry County (Ind.) Rural Electric Membership Corporation at a meeting at Newcastle have voted to sever relations with the Indiana statewide REMC as soon as the present engineering and construction contracts expire. Board members contend the expenditure for relations between the local unit and the Indianapolis officers are in excess of the benefits.

M. J. Briggs, manager of the Indiana statewide REMC, said he had not been notified of the action. "That may be the choice of Henry County," he said, "but in a statewide meeting recently sixteen counties voted to act through the state organization, representatives of six counties were not present at the meeting and four counties did not vote."

•

Missouri Valley Group Holds Rural Meeting

Losses on operation alone, with no consideration at all given to fixed charges; lines erected and standing idle because signers of applications for co-operative loans later refused, in large numbers, to become actual customers; lines projected and loans granted for lines ot three customers and when built serving less than one customer per mile, and other matters relating to the activities of the Rural Electrification Administration enlivened the discussion of farm service at the Rural and Sales Conferences of the Missouri Valley Electric Association in Kansas City, Mo., held last week. Reports on REA activities in Iowa, Kansas, Missouri, Nebraska and Oklahoma were presented by representatives of each state.

The ideal utility salesman to do business with farmers must be a friendly sort of fellow who has time to visit a little, who knows what the farmer wants and does not try to high

Holophane Co., Inc.

BETTER LIGHTING—New lighting arrangement in the showroom of General Electric Supply Corporation, Milwaukee, which has 300-watt controlens. Spacings are 14 ft. 6 in. x 5 ft. Ceiling height is 14 ft. 2 in. Intensity is 90 foot-candles (from "In-Bilt" units only). Also installed are ten 500-watt wall urns. Intensity is 28 foot-candles (from wall urns only). Reflection factor of ceiling is 75 per cent and walls 60 per cent

pressure the sale of what he does not want and who, in fact, knows farming first and salesmanship second. These are the ideas expressed by Mrs. J. C. McKinney, a farmer's wife from Hartford, Kan., who spoke on the farm customer's angle on merchandising.

D. E. Wiant, Kansas State College of Agriculture, described a survey that is being made in Harvey County of that state, the purpose of which is to determine, if possible, in quantitative terms the possibilities of electrification in a typical Kansas area. It would seem from the data so far collected and analyzed that the Kansas farmer wants and needs quite a few other things before electric service. This arresting thought gets some corroboration from the results of an investigation reported to the meeting by G. A. Walker, Nebraska Power Company, on a line in service for a number of years and to which over a third of the possible customers had contentedly remained unconnected.

The utilities are not tying in as they should to the national promotion programs said G. W. Allison, E.E.I., speaking on kitchen modernization. From the discussion on dealer relations, in which J. F. Porter, Jr., Kansas City Power & Light Company, and R. C. Geppert, Nebraska Power Company, were among others who took part, there was to be derived the conclusion that dealer subsidies of whatever kind were unnecessary and perhaps harmful except in the numerous cases in which they were just the opposite. About the same clarity of conclusion was possible from the symposium on financing plans in which Harry Makeever, Peoples Gas & Electric Company; F. H. Elvig, Kansas Power Company, and E. G. Nichols, Iowa Electric Light & Power Company, participated.

The national program for the promotion of adequate wiring was described by C. V. Dunn, Kansas City Power & Light Company. Albert L. Maillard, of the same company, said that air conditioning ought to be a pretty good thing for the utilities.

W. H. Stueve, Oklahoma Gas & Electric Company, presented some comforting reassurances regarding Diesel engine competition, pointing out that it is not so important now as the current Diesel publicity makes it appear and that it will probably be much stronger in the future than many utility executives like to contemplate.

L. C. Porter, G. E. lamp department, gave a showing of the new sound film on "Better Light-Better Sight" in the country and got the rural service men present pretty enthusiastic about the possibilities of egg production with ultra-violet light.

Named Vice-President

Davis M. DeBard, sales engineer of Stone & Webster Service Corporation, was elected vice-president this week. For the past twelve years Mr. DeBard has been general sales engineer of the operating properties of the Stone & Webster system.

Widely known for his interest in furthering the use of electricity, Mr. DeBard has been chairman of the Edison Electric Institute sales committee for the last two years. He recently completed a three-year survey of the electrification of low income customers on lines in Norway, Sweden, Denmark, Finland, Switzerland, England, Scotland, Italy, Germany, Holland, France and Spain.

Mr. DeBard was for many years power sales engineer of the Edison Electric Illuminating Company, Brockton, Mass., and first president of the New England Central Station Association of Power Engineers. He is widely known in utility circles in this country and in Europe.

•

Restricts Former Employees

Federal Power Commission has adopted an order prohibiting any former commissioner, officer or employee from appearing or assisting in any proceeding before the commission within one year after separation from its service. Acting Chairman Clyde L. Seavey and Commissioners Claude L. Draper and John W. Scott concurred in the adoption of this rule. Commissioner Basil Manly dissented.

•

Starts New Transformer

General Electric Company, Pittsfield, Mass., has started work on a 215-ton transformer, said to be larger and heavier than any other made by the company. The unit will be 25 ft. 9 in. high and will occupy floor space 21x27 ft. It will be delivered to Potomac Electric Power Company, Washington, D. C. The transformer was ordered by Consolidated Gas, Electric Light & Power Company, Baltimore. It will be used as part of the power tie-in between Washington and Baltimore.

•

Westinghouse Plans to Build New Factory

Westinghouse Electric & Manufacturing Company plans early construction of new manufacturing and warehouse facilities at its East Springfield (Mass.) Works especially to meet the growing demand in the air-conditioning field.

While the expansion program will partly take care of the large amount of business in air conditioning that seems certain in connection with activities in new types of housing, part will be to accommodate certain manufacturing operations which will be transferred from the Chicopee Falls (Mass.) Works. Recently the company announced that all the radio operations at Chicopee Falls would be transferred soon to a plant which has been acquired at Baltimore, Md.

L. E. Osborne, Westinghouse works manager at East Springfield, stated that the new manufacturing building will have approximately 100,000 sq.ft. of floor space. Activities in the new plant will include manufacture of beverage coolers, water coolers and commercial refrigeration units. The room cooler type of air-conditioning equipment will also be manufactured in the new quarters.

It is estimated that the program will call for an expenditure of $1,250,000. It is also expected that additional personnel will be required in the new operations.

•

Industrial Equipment Exhibit

The Electrical League of the Niagara Frontier will hold an industrial equipment exhibition in the Hotel Statler, Buffalo, N. Y., from March 31 to April 2.

•

Westinghouse Pays Bonus

A profit-sharing bonus of 3 per cent was authorized this week by the Westinghouse Electric & Manufacturing Company for all workers in March, compared with 4 per cent paid for the three preceding months. Last year the extra disbursement reached as high as 14 per cent monthly.

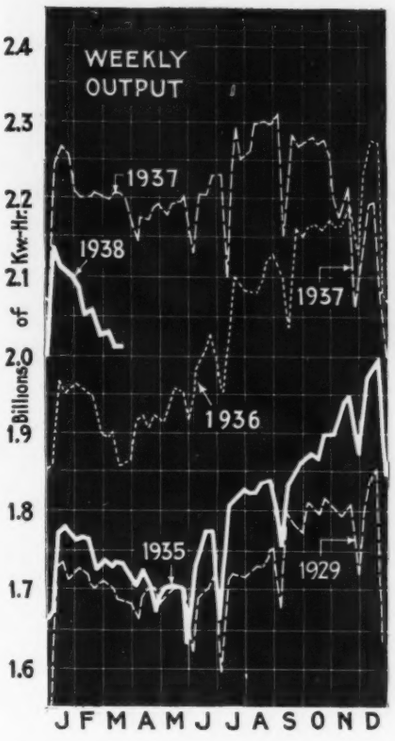
Output Maintains Level

Equals previous week's — Mid-Atlantic area nearest 1937— Rocky Mountain lowest

Again registering a check in the downward movement, the output of energy by the electric light and power industry during the week ended March 19 advanced slightly over that of the preceding week to 2,017,653,000 kw.-hr., according to the Edison Electric Institute.

While operations continue to be below the 1937 level, there was a small relative improvement, the deficiency being 8.7 per cent, as against 9.0 per cent in the week of March 12. Compared with 1936 there was an increase of 6.2 per cent.

Regional changes referred to last year continue much the same as in the recent past, reflecting local industrial conditions. The smallest losses were in the Middle Atlantic and Pacific states, the largest in the Rocky Mountain, now up to 18.1 per cent, against 1.4 per cent earlier in the year. Losses remain large in New England and the Central Industrial region.



Weekly Output, Millions of Kw-Hr.

1938	1937	1936
Mar. 19..2,018	Mar. 20..2,211	Mar. 14...1,901
Mar. 12..2,015	Mar. 13...2,213	Mar. 7...1,893
Mar. 5..2,036	Mar. 6...2,200	Feb. 29...1,903
Feb. 26..2,031	Feb. 27...2,207	Feb. 22...1,942
Feb. 19..2,059	Feb. 20...2,212	Feb. 15...1,950
Feb. 12..2,052	Feb. 13...2,200	Feb. 8...1,952
Feb. 5..2,082	Feb. 6...2,201	Feb. 1...1,963

Per Cent Change from Previous Year

Region	Week Ending Mar. 19	Mar. 12	Mar. 5
New England	−12.8	−12.4	− 9.8
Middle Atlantic	− 2.8	− 3.6	− 1.1
Central Industrial	−15.6	−16.6	−15.3
West Central	− 7.5	− 4.4	− 4.9
Southern States	− 5.1	− 5.0	− 6.0
Rocky Mountain	−18.1	−17.2	−14.4
Pacific	− 3.8	− 0.9	− 1.4
United States	− 8.7	− 9.0	− 7.5

Kansas Utility Act Is Denied Review

The U. S. Supreme Court has refused to review the Kansas State Supreme Court decision that the state's public utilities act is constitutional when interpreted to allow a municipal utility to invade a distant territory in competition with a privately owned utility already operating in the area without obtaining a certificate of public convenience.

Kansas Gas & Electric Company had appealed from the state ruling on the ground that it was deprived of equal protection of the laws under the Fourteenth Amendment if the exemption of municipal utilities from regulatory jurisdiction of the state Corporation Commission as to rates and service extended to service outside the municipality.

The city of McPherson, with a public power plant, arranged to supply electric energy to the city of Moundridge, Kan., 17 miles away. Moundridge and consumers in its vicinity had for some time been buying energy from Kansas Gas & Electric Company. The utility company sought an injunction to require the city of McPherson to obtain a certificate of public convenience.

•

Power Saving for Consumer

Any saving made by private electric utilities in purchasing their power supply from Bonneville Dam must be passed on to the consumer and not retained by the utility for distribution among stockholders as dividends, Governor Martin of Oregon declared in a letter to J. D. Ross, Bonneville administrator.

•

Residential Sales Gain 10%

Average kilowatt-hour sales per residential customer by the Georgia Power Company for the twelve months ended February 28, 1938, totaled 1,335, as against 1,214 for the corresponding period of last year, a gain of 10 per cent. During the month of February kilowatt-hour sales per residential customer gained 8.6 per cent over February, 1937.

•

Nebraska Utility Head Denies Rumors of Sale

In response to numerous questions raised by the reports published recently that the public power districts were still announcing their intentions of acquiring the privately owned utilities in Nebraska, L. R. King, president of the Iowa-Nebraska Light & Power Company, stated:

"I feel it necessary to reiterate my statement made on previous occasions, that the Iowa-Nebraska Light & Power Company is not for sale to any one. I had hoped that we had made our position clear in this matter on the occasion of my previous statements in this regard, but apparently the promoters of this so-called 'mass purchase' either refuse to read, or refuse to believe, that we mean exactly what we have said."

•

Designs Grand Coulee Units

The United States Reclamation Bureau at Denver, Colo., is designing main units for Grand Coulee Dam, three of which are to be purchased this year. Each is to be of 120,000 kva., driven by a 150,000-hp. hydraulic turbine, with a separate motor-generator exciter for each. Two 12,500-kva. hydro station units are also planned, according to R. F. Walter, chief engineer.

•

District Engineers to Meet

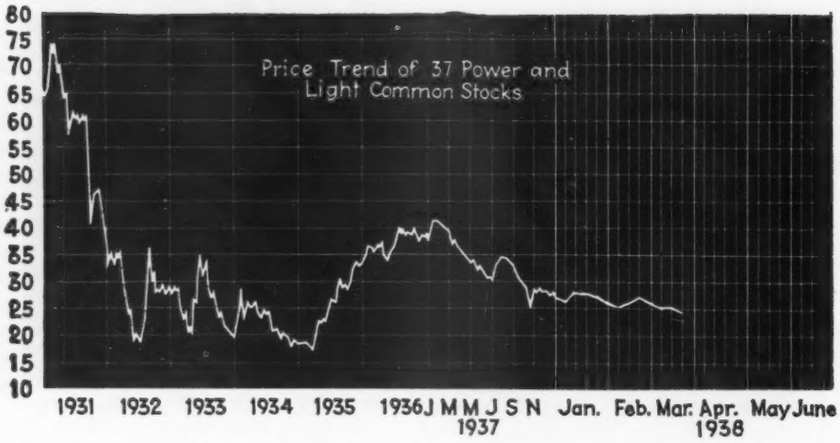
The District of Columbia Society of Professional Engineers will hold its next meeting on March 28 at the Meridian Room, 2400 Sixteenth Street, N. W., Washington, D. C. A new sound motion picture will be shown, "Approved by the Underwriters," by Underwriters Laboratories, Inc., Chicago, Ill.

•

Will Hear Rate Complaint

FPC will hold a hearing in its regional office in Chicago on March 28 on the complaint filed by the village of Albany, Ill., alleging that the rates for electric energy charged by the Albany Lighting Company, an Iowa corporation, are excessive, unjust and unreasonable, and requesting that, after investigation, fair and reasonable rates be established by the commission.

Utility Stocks Drop to New Low



Electric power and light stocks this week dropped to a new low, the "Electrical World" index losing one point. Index this week, 24.4, lowest since week of June 8, 1935. Index previous week, 25.4; corresponding week a year ago, 36.2

Utilities Register Statements with SEC

Among the statements which have recently been filed by utility companies with the SEC are the following:

Columbia Gas & Electric Corporation has filed an application under the holding company act for approval of the payment of certain dividends during the year 1938 out of its surplus account as designated on December 31, 1937. Hearing has been set for March 30.

United American Company of Chicago, Ill., and Iowa-Nebraska Light & Power Company, Lincoln, Neb., have filed notifications of registration under the holding company act. These companies are associated with United Light & Power Company system.

Gardner Electric Light Company, Gardner, Mass., a subsidiary of New England Power Association, has filed a declaration covering the issuance of two 3 per cent one-year unsecured notes each of $200,000, the proceeds of which will be applied primarily to the payment of maturing bank loans and to intercompany indebtedness incurred in the making of plant and equipment extensions, additions and improvements.

Cape & Vineyard Electric Company has filed registration with SEC for $1,000,000 first mortgage bonds, proceeds of which, together with issuance of 20,000 shares of common stock, will be used to pay floating indebtedness of $306,250 and to pay advances on an open account to New England Gas & Electric Association, totaling $971,500 as of December 31, 1936.

•

Gets Assent to Power Plan

Committee representing holders of the 7 per cent cumulative preferred stock of the Mountain States Power Company, headed by David Soliday of Hopper, Soliday & Company, investment firm of Philadelphia, has announced that it has received assents from more than 1,300 shareholders, representing $1,800,000 of the issue, or in excess of 30 per cent of the total of $5,304,400 outstanding.

Request for assents from other holders is being made by the committee, according to the announcement. The committee was formed previously following recent filing by Mountain States Power of a petition for reorganization under Section 77b of the Federal Bankruptcy Act in the United States District Court in Wilmington, Del.

•

Exemption Obtained by General Electric

General Electric Company and its wholly owned subsidiaries, the Electrical Securities Corporation and the G. E. Employees Securities Corporation, have obtained from the SEC exemption until December 31, 1939, from provisions of the public utility holding company act of 1935, which would require registration. They also obtained the right to apply on or before that date for an extension of the time or for unlimited exemption.

The limited exemption resulted from the fact that the portfolios of the securities corporation and the employees' corporation, on June 30, 1937, contained, respectively, securities of about 80 and 85 public utility and holding companies, and, in the instances of New England Public Service Company and Texas Power Corporation, 26.44 per cent and 12.59 per cent of voting power. The commission found that no "serious evils" were likely to arise because of holdings in Texas Power. As to holdings of other utility companies, the commission revealed that in no instance did they represent as much as 5 per cent of the voting securities, except in the case of a holding of 7.26 per cent of the voting stock of the British Columbia Power Corporation, Ltd.

Most of the utility securities owned by General Electric, it was explained, were acquired in payment for electrical equipment.

•

E. J. Poor Sees Improvement for Industry Later in 1938

E. J. Poor, chairman of the board, Hygrade Sylvania Corporation, predicted recently that practically all lines of U.S. industry would enjoy a decided improvement during the latter part of 1938, unless adversely affected by the European situation. He made this prediction following a ten-day business tour of the Eastern, Mid-Atlantic and Mid-Western States.

According to Mr. Poor, he found a "marked note of optimism" among industrialists, large and small, and their sales organizations. In addition, he stated, he found that large inventories, for the most part, had been liquidated and that manufacturers generally are preparing for considerable capital improvements during the fall and winter.

•

McCain Says Business Good

Charles S. McCain, chairman of the board, American Light & Traction Company, this week reported that business, as a whole, was generally satisfactory throughout the company's territory. Speaking before the annual meeting of stockholders, Mr. McCain said the utility was faced with no new financing problems, but itemized three minor borrowings it might undertake.

Earnings Reports (Utilities)

	Net Income 1938	1937
†The Detroit Edison and subs.	$8,961,631	$10,705,248
‡Assoc. Gas & Elec. and subs.	35,304,264	36,298,712
	1937	1936
*South. Calif. Edison	12,136,162	12,760,560
*Buffalo, Niag. & East. Pwr.	5,939,856	5,183,099
*N. Y. Pwr. & Lt.	3,213,143	2,945,808
*Buffalo Niag Elec.	3,547,961	3,694,272
*Niag., Lockport & Ont. Pwr. and subs.	1,089,779	1,357,819
*Kansas City Pwr. & Lt.	4,360,143	4,710,405
*Central Ill. Pub. Serv.	1,508,688	1,542,506
*Arkansas Pwr. & Lt.	1,422,070	1,098,786
*Florida Pwr. & Lt.	1,926,440	1,455,629
*Louisiana Pwr. & Lt.	1,171,935	1,058,865
*Carolina Pwr. & Lt.	2,564,681	2,115,366

† Twelve months ended February 28.
‡ Twelve months ended January 31.
* Twelve months ended December 31.

Municipal Plant Tax Totals 5% of Revenue

Sales of electric energy during 1937 by the Jamestown, N. Y., municipal electric system totaled 49,561,004 kw.-hr., according to the annual report. Electric operating revenues totaled $1,008,764 during 1937, as compared with $949,490 in 1936.

The report also shows that taxes paid by the system on electric operation during 1937 were $4,284; payments to the municipality in lieu of taxes were $43,323, making the total $47,607. Compared with gross revenue, this is equivalent to slightly less than 5 cents per dollar of revenue. National average of taxes paid by private utilities in 1937 was about 15 cents per dollar of revenue.

Net income transferred to surplus of $401,949 is indicated in the report, although no deductions are shown for depreciation or retirement reserve. Compared with the reported net income, tax payments plus payments in lieu thereof were about 12 per cent of this amount; for private utilities, 23 per cent of net income, before depreciation and interest, went for taxes in 1937.

•

Hardy County Co-operative Receives Another Set-Back

The state of West Virginia has advanced another step in its fight to compel the Hardy County Light and Power Association to subscribe to state Public Service Commission supervision. Circuit Judge Harlan Calhoun has refused to dissolve a temporary injunction granted by the Supreme Court of the state, which forbade future activities of the REA-financed co-operative until it obtained commission approval.

Judge Calhoun directed the Public Service Commission to begin taking evidence this week to support its petition for a permanent injunction against the co-operative. The association, which has contended it is not a public utility, requested immediate dissolution of the order to forestall irreparable damage.

•

New Orleans Association Honors Electric Pioneers

Eight pioneers in electrical development were honored at a luncheon given recently in New Orleans at which golden anniversary certificates were awarded. The occasion was the Pioneers' Banquet, sponsored by the Electric Association of New Orleans. President F. W. Stevens presided. A. B. Paterson, president of New Orleans Public Service, Inc., made the awards.

Among the pioneers who received awards were Charles A. Goslett, an associate of the late Thomas A. Edison; Col. C. Robert Churchill, known internationally for his work in electrical circles and who has been prominent in New Orleans since 1889; Gabriel O. Correjolles, electric elevator pioneer; C. S. Barnes, contractor; Robert M. O'Brien, street railway equipment expert; S. B. Swift, bell and speaking tube equipment pioneer; Henry M. Muller, who has long been affiliated with New Orleans Public Service, and Henry J. Malochee, who, since 1889, has been prominent in electrical development in and around New Orleans.

•

Florida Utility Adopts Monthly Basis Budget

Due to unsettled conditions, directors of Florida Power & Light Company have not seen fit to adopt a construction budget for this year, according to Bryan C. Hanks, president. Mr. Hanks said that expenditures from month to month are being approved on a basis of necessity and requirements.

Last year the company spent approximately $1,454,000 on new construction. This included $50,000 for generating stations, $204,000 for transmission and substations and $1,200,000 for distribution facilities. During the year the company constructed approximately 90 miles of rural lines serving approximately 1,200 new customers.

During last year 5,045 electric ranges, 2,616 water heaters, 16,208 refrigerators and approximately 145,000 minor electric appliances were sold in the company's territory by electrical dealers and the company's own sales organization, Mr. Hanks stated. Due to the extensive dealer sales co-operation plan which the company carries on, Mr. Hanks declared, about 90 per cent of the appliances were sold by dealer sales organizations.

•

EHFA Signs New Contracts

Electric Home and Farm Authority has announced that a contract has been closed with the city of Roseville, Calif., which owns and operates the local municipal utility. Contracts have also been closed with the Monona County Rural Electric Co-operative, Onawa, Iowa; Trempealeau Electric Co-operative, Arcadia, Wis.; Stearns Co-operative Electric Association, Melrose, Minn.; Buffalo Electric Co-operative, Alma, Wis.; Douglas County Co-op Light and Power Association, Alexandria, Minn., and Simsbury Electric Company, Simsbury, Conn.

Aiken Says Vermont Opposes Flood Bills

Gov. George D. Aiken of Vermont delivered another outspoken assault on the efforts of the Washington Administration to wrest flood control from the hands of the New England states at a recent meeting in Boston. He declared that Vermont would not drop its opposition to the plan sponsored by President Roosevelt, which, he protested, would put the nation's chief executive in a dominant position over natural resources and industries.

"Washington," said Governor Aiken in part, "has capitalized on the animosity of the people toward the utility companies. . . . Attached to the bills, which purport to afford flood protection and provide electric power at lower rates, are provisions which would give to the White House control over all land and water resources and all industry.

"Vermont is ready to co-operate with her sister states at any time," Governor Aiken said, "but we cannot surrender our natural resources and jurisdiction over agriculture and industry and thus give up the means by which we have been a self-supporting state for more than a century and a half . . . We are not ready to have the Secretary of War, also appointed by the President, say which of our valleys are to be flooded without our consent. . . . We are not yet ready to say that all business shall be controlled by boards appointed by the President and which shall have authority to shuffle our industries like blocks in a child's toy set."

•

Requests Rate Reduction

Michigan Public Utilities Commission has announced that the Michigan Gas & Electric Company, Dowagiac division, has filed a petition asking for a reduction in its rates for the purpose of meeting competition of the Dowagiac municipal plant. According to the petition, the company seeks to establish the same rates as those of the city-owned plant. It is the company's contention that loss of customers because of municipal competition will burden customers in other nearby sections of the state.

•

Fail to Purchase Line

Inability to raise sufficient funds prompted employees of the Lake Shore Electric Railway Company to abandon their plans to purchase the interurban line operating between Cleveland and Toledo and operate it as a co-operative. Toledo Edison has acquired the line.

Moves Made to Clear Pacific Coast Tangle

In swift succession, three developments recently changed the aspect of Sacramento Municipal Utility District's efforts to secure a $4,000,000 PWA grant and to make use of a proposed $12,000,000 bond issue, and at the same time appeared to spell collapse of a proposed compromise between Pacific Gas & Electric Company and the district.

It had been proposed that the district forego plans to condemn, purchase or duplicate the company's Sacramento distribution system and that the company purchase all output of a projected district hydro plant at Silver Creek.

The developments:

1. PWA ruled that its loan and grant could not be used for a hydro plant at Silver Creek because such could not be completed by June, 1939.
2. Lester Ready and J. G. Butler, consulting engineers, recommended to the district's board that it undertake condemnation and purchase of P. G. & E. distribution facilities rather than attempt to parallel the system.
3. Ready, as consulting engineer for the California Water Authority, recommended against that body's approving a Silver Creek plant on grounds it would interfere with future marketing of power from Shasta Dam, key unit in the California Central Valleys Project.

Mr. Ready urged that the district build a steam plant, since steam standby for Shasta Dam power eventually would be required.

Following recommendation of [condemnation and purchase] would also preclude securing the PWA money. Efforts to secure these funds were a major reason for the proposed company-district compromise.

•

School for Executives

Announcement has been made by Frank J. Healy, general manufacturing manager of the Hygrade lamp division of the Hygrade Sylvania Corporation, of the inauguration of a school for his executive organization. Through it company officials are giving all department heads a thorough course in all workings of the company so that each will have an intimate and comprehensive knowledge of the work of all other departments.

•

Local Appliance Meetings Attract 30,000 Persons

More than 30,000 persons attended the 36 district conventions held coast-to-coast in late January and February by Frigidaire division, General Motors Sales Corporation, Carl A. Copp, general sales manager has announced. In 1937 the attendance totaled 26,688. The increase in attendance was interpreted by Mr. Copp as indicative of the increased interest of electrical dealers, department and furniture store management and merchandising executives and public utility management and merchandising executives in the marketing of electric refrigerators and electric ranges.

•

Frigidaire Opens Campaign

Announcement has been made by Thomas W. Markham, commercial advertising and promotion manager, that the commercial sales division of Frigidaire division, General Motors Sales Corporation, beginning immediately, will inaugurate the most aggressive advertising campaign ever put behind the marketing of Frigidaire commercial refrigerating equipment.

Meetings

Edison Electric Institute—Sales committees, Edgewater Beach Hotel, Chicago, Ill., March 28-31. Bernard F. Weadock, managing director, 420 Lexington Ave., New York, N. Y.

Missouri Valley Electric Association—Engineering conference, Omaha, Neb., April 7-8. I. D. Pettigrew, assistant director, 1527 Sharp Building, Lincoln, Neb.

Midwest Power Conference—La Salle Hotel, Chicago, Ill., April 13-15. L. E. Grinter, Dean, Graduate Division, Armour Institute of Technology, Chicago, Ill.

American Chemical Society — Semi-annual meeting, Dallas, Tex., April 18-21.

Greater New York Safety Council—Annual convention, Hotel Astor, New York, April 19-21. Julien H. Harvey, executive vice-president, 60 East 42nd Street, New York, N. Y.

Missouri Association of Public Utilities—Annual convention, Jefferson Hotel, St. Louis, Mo., April 20-22. Jesse Blythe, assistant secretary, Merchants Bank Bldg., Jefferson City, Mo.

Northwest Electric Light and Power Association — Annual meeting, engineering and operation section, Vancouver, B. C., April 20-23. Berkeley Snow, executive secretary, 707 Spalding Bldg., Portland, Ore.

Southeastern Electric Exchange — Annual conference, Edgewater Gulf Hotel, Biloxi, Miss., April 21-23. John Talley, executive secretary, 308 Haas-Howell Building Atlanta, Ga.

Electrochemical Society — Spring meeting, Savannah, Ga., April 27-30. Dr. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Association of Iron and Steel Engineers—Annual spring conference, Baltimore, Md., April 28-29. Brent Wiley, managing director, Empire Building, Pittsburgh, Pa.

Maryland Utilities Association — Annual meeting, Lord Baltimore Hotel, Baltimore, Md., April 29. E. J. Roche, secretary, 55 E. Washington St., Hagerstown, Md.

Midwest Power Meet Plans Full Program

"Trends of Research in the Power Industry" by C. F. Hirshfeld, chief of research Detroit Edison Company, and "Social Significance of Power Progress" by Phil Swain, editor of *Power*, are announced as the high lights of the general opening session of the Midwest Power Conference in Chicago, April 13–15.

The technical sessions of the remaining time of the conference will cover fuels, trends in electric power equipment, locomotive power units, developments in stationary power plants, power measurements, valuation of power plants, metals, operating problems and hydro power. Luncheon meetings will be addressed by W. S. Monroe on "Some Economic Aspects of High Pressure Steam Plants" and by Frank F. Fowle on "The Nation's Power Bill."

The conference, well known in the Middle West, although of late years almost moribund, has been revived under the sponsorship of the Armour Institute of Technology in co-operation with Iowa State College and Purdue, Iowa, Illinois, Michigan and Wisconsin universities.

•

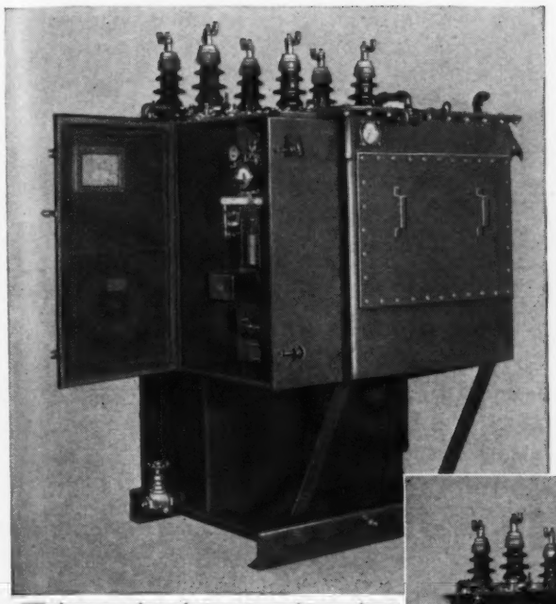
Anaconda Wire Wins Award

Judges of "Modern Packaging's" 1937 All-America Package Competition have voted the award to the Anaconda Wire & Cable Company for its initial efforts in redesigning its 500-odd wire and cable packages. The new design motif embodies the former color scheme of black and orange and the well-established Anaconda spearhead trademark, but the color units have been consolidated into a few simple standard areas to convey a definite trademark impression. It was selected because of its strong visibility, easy readability, trademark value and because its simplicity permitted application to various types, sizes and proportions of packages.

•

Moves to New Elgin Plant

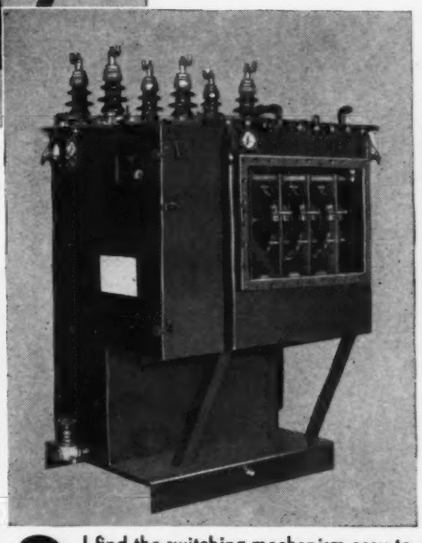
McGraw Electric Company has just moved its organization from Minneapolis to its recently completed $250,000 plant at Elgin, Ill. The new plant was made necessary by the continuous expansion of the business which outgrew its Minneapolis quarters. The entire plant will be devoted exclusively to the manufacture of "Toastmaster" and "Thermotainer" products. The company also manufactures electric fuses and Clark electric water heaters. Other factories are located in St. Louis and in Clearing, Ill.



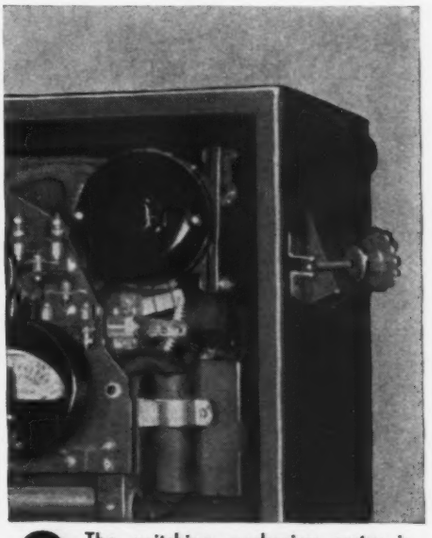
1 I save a lot of time in making adjustments and inspections, because the control cabinet is located at just the right height.

Dear Ed:

You asked me why I like G-E step voltage regulators. As one operating man to another, I'll say there are a lot of reasons. For instance . . .



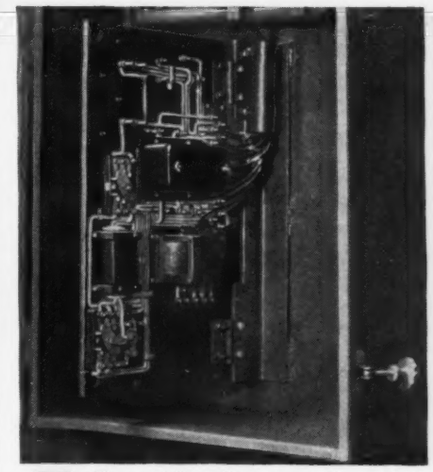
2 I find the switching mechanism easy to get at, because there are removable plates on both the top and the side of the housing.



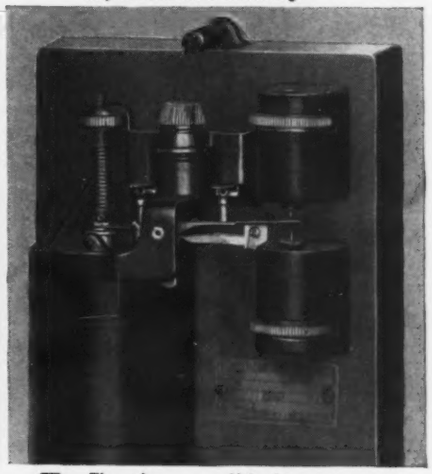
3 The switching mechanism motor is located right in the control cabinet—not submerged in oil. You know what that means in time saved on routine inspections and servicing.

4 You don't have to fuss and fume over hand operation. You just turn the permanent hand wheel near the position indicator in the control cabinet.

Many power companies have found G-E 3-phase step voltage regulators a low-cost way to improve voltage conditions on their circuits, 4800 volts and higher. General Electric's Bulletin GEA-1577D will tell you all about these regulators. Address General Electric, Schenectady, N.Y.



5 It's no trick at all to inspect the control wiring; it's on a hinged panel that swings out from the back of the control cabinet.



6 Then there are self-locking micrometer adjustments on the voltmeter. They make it simple to do an accurate job of setting the mean voltage level and the width of the voltage band.

GENERAL ELECTRIC

350-139

Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Devise Bar Lock for FeederCompartments

By F. J. MURMANN
Superintendent Substation Operation
Westchester Lighting Company,
Mount Vernon, N. Y.

In designing a scheme for locking substation compartments housing energized circuits, four fundamental requirements were set up by the Westchester Lighting Company. Scheme must be: (1) Impossible to remove without unlocking or breaking. (2) Easily broken in an emergency. (3) Simple and easily installed. (4) Inexpensive.

The scheme adopted by the company meets all of these requirements. As shown in the accompanying sketch the scheme consists of a $1\frac{1}{2}$x$\frac{1}{2}$-in. oak bar of a length depending upon the width of the compartment to be locked. It is held in position at one end by a brass socket-type fixture and on the other end by a brass tongue screwed to the compartment casing and protruding through a slot in the bar far enough to allow a padlock to be slipped through a hole in the tongue, securing the bar.

Since all the screws that secure the brass fixtures to the compartment are covered when the bar is in place and the padlock closed the device cannot be removed by taking out the screws. It must be either broken or unlocked. In case of emergency the oak bar is not too stout to be easily broken with a clawhammer. The two brass fixtures, the oak bar and the four screws are all the material required for each lock.

An additional feature of the device as devised by this company provides that the same key fit the padlock on every compartment associated with the same feeder. Padlocks cannot be shifted from one compartment to another since they are fastened to the compartment casing by a small chain.

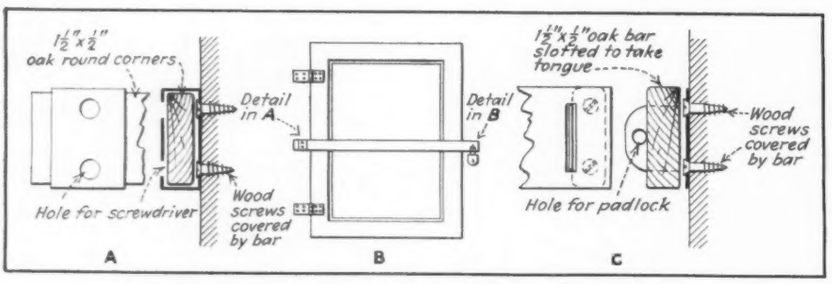
•

Gas Pressure Relays Protect Transformer

Gas pressure relays, used principally for transformer protection, but also applicable to tap changers, static condensers, Petersen coils and induction regulators, have been in use in some countries for ten or fifteen years. In Germany about 80 per cent of all transformers over 5,000 kva. are so equipped, the smallest size so protected being 50 kva., the E.E.I. electrical apparatus committee found. The relay, which is generally furnished with the transformer, is connected to set off an alarm at the slow accumulation of gas, but to trip the breaker at the sudden appearance of gas within the transformer. In Germany differential protection is used in addition to the gas pressure relay, to provide protection for the bushing and switches, but in Switzerland gas pressure relays alone are used. In one case the gas pressure relay is reported to have functioned on the occasion of the burning of contacts on the tap changer, where the differential protection did not function because there was no flash to ground.

Advantages cited for the gas pressure relay are simplicity, ability to discover failures at their inception, with the associated advantages of diminishing the extent of transformer damage and the elimination of the need for elaborate testing to indicate that the protective system is properly connected. It is reported that, with the damage minimized, insurance companies are generally more willing to settle for the full amount of the damage.

Disadvantages cited are the false operation from the starting and stopping of oil circulating pumps, gas in the oil when no fault exists in the transformer, excessive royalty cost and the necessity of making a thorough test on each model. At least one case is reported in which



Four-piece device locks substation compartments

Note that since the slot for the brass tongue taking padlock is vertical the padlock does not hang at an unsightly angle

GLYPTAL CLOTH

Three-conductor, interlocked armor—for general-purpose wiring in industrial plants. Offers the advantage of metal-enclosed circuits which can stand high ambient temperatures, overloads, and oil. Easily installed with standard conduit fittings; results in over-all savings.

Glyptal cloth braided—for general-purpose industrial-motor wiring; for rewiring mining and industrial locomotives and other apparatus. Braid is moisture-resisting as well as flame-resisting. Cable can stand up under *heat, oil, acids,* and mechanical abuse. Has proved ideal for this service.

VERSATOL PERFORMITE

A rubber insulation that combines all three most desirable properties: high operating temperature—75 C; low moisture-absorption factor—0.01 gram per sq in.; and superaging—504 hours in oxygen bomb.

Application: General-purpose wiring of important circuits in industrial plants and for other uses requiring such high-grade rubber-insulated cable.

FLAMENOL

For the wiring of machine tools, panels, for battery leads, for chemical plants, sewage-disposal plants, pickling plants, plating machines, printing machines, and other uses.

Flamenol resists acids, alkalies, oils, water, and flame—will not sustain combustion; has a small diameter and high dielectric strength.

TELLURIUM

A tough, long-life, all-rubber sheath. Used on cable for mining machines, electric shovels and dredges, arc welders, and other portable equipment.

For "parkway" cable and similar uses where the cable is required to withstand mechanical abuse, soil acids, alkalies, and moisture. May be buried in soil, cinders, pulled in conduit, or laid under water.

Offer

NEW Solutions to Insulated-cable Problems

PRODUCTS of extensive research have made possible these exclusive G-E cables. One such product is the amazingly fast organic accelerator used in the vulcanization of Versatol Performite and of tellurium-rubber compounds. Another is the base of the varnish used for Glyptal cloth. Still another is the base of Flamenol.

As a result of this development work, you can give more effective thought to the satisfactory solution of such problems as oils, acids, alkalies, heat, flame, moisture, corona, and other agents that attack cable.

Learn the real worth of these four G-E cable designs and see if they can work for you as satisfactorily as they have for many other users. A G-E cable specialist will be glad to help. Address the nearest G-E sales office, or General Electric, Schenectady, N.Y.

ALWAYS THE ***RIGHT*** **TYPE FOR EACH JOB**

GENERAL ELECTRIC

Filing No. 1200 520-131

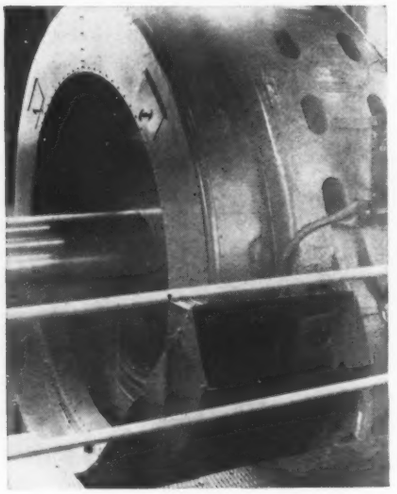
the gas pressure relay did not operate fast enough to avoid serious damage to the transformers.

•

Air Baffles Reduce Machine Temperature

By L. M. ROBERTSON
Transmission and Station Engineer
Public Service Company of Colorado

Installation of air baffles on two 12,500-kva. waterwheel generators has reduced the machine temperatures and permitted higher loading in hot weather. The two machines



Baffles conduct hot air from generator pit

at the Boulder Canyon plant of the Public Service Company of Colorado were originally installed in 1909. Rated 5,000 kw. each, they were connected to impulse waterwheels operating under a static head of 1,827 ft. and were of horizontal type with a portion of the stator below floor level in a pit.

From time to time the machines have been rebuilt. The last time, 1936, both generators were rebuilt with new fields, field-supporting structures, stator iron and coils, thus increasing the rating to 12,500 kva. each.

After this last rebuild it was found that rather high temperatures prevailed in the machines as follows:

Coil temperature in unit A, 92 deg. C. for a load of 10,350 kva. (4,500 kw.), 1,450 amp.; coil temperature in unit B, 90 deg. C. for a load of 10,250 kva. (4,500 kw.), 1,450 amp.; temperature of air in pit of unit A, 59 deg. C.; room temperature, 32.8 deg. C.

After some study it was found that a considerable part of the cooling air leaving the generator was being discharged into the generator pit and not being conducted away, but being picked up and recirculated. This resulted in the cooling air temperature being much higher than the air temperature in the room.

An experimental baffle was then tried as a temporary measure. It was made up of plywood so that no disastrous results would follow if some of the temporary structure should get loose. The results were very gratifying and permanent steel baffles were installed as shown in the accompanying illustration.

Results were as follows:

Coil temperature in unit A, 91.5 deg. C. for a load of 12,840 kva. (9,000 kw.), 1,800 amp.; coil temperature in unit B, 87 deg. C. for a load of 11,790 kva. (1,800 kw.), 1,650 amp.; temperature of air in the pit of unit A, 37 deg. C.; room temperature, 33.5 deg. C.

With the same room temperature it has been possible to increase the loading on the machines with the same or somewhat lower coil temperatures.

•

Secure Transformers to Highway Poles

To prevent transformers mounted on wood poles from being jarred off when the pole is struck by an automobile or truck, an Eastern power company has adopted the method of sling fastening described below:

Fastening—Single transformers shall be fastened to pole by means of a sling installed in accordance with the following instructions and drawings:

1. Drive lag screw (Item 1) with one washer (Item 2) into pole on side opposite transformer at about one-third the height of the transformer, leaving one inch to be screwed in. If secondary arm interferes, place the lag one inch above the top of this arm.

2. Loop two strands (Item 3) around transformer and pole, drawing hand-tight, and make one complete turn around lag with each pair of ends, starting one turn over and the other under the lag (Fig. B).

3. Drive two staples (Item 4) over each pair of ends, one as near as possible to the washer and the other one inch from ends.

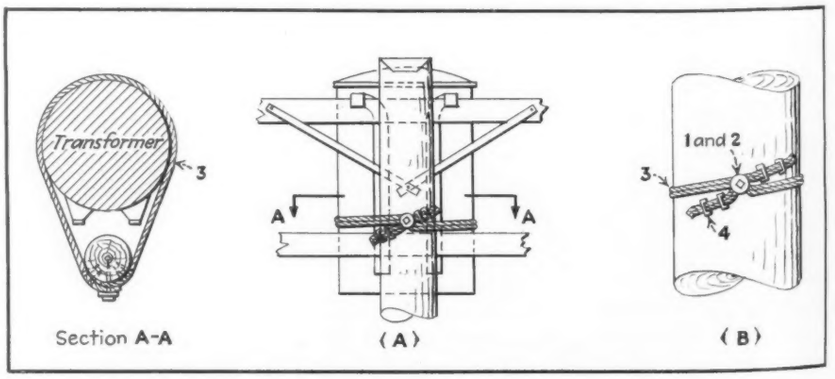
4. Screw lag into pole, clamping strands tightly between washer and pole.

•

Extend Range of Voltage Compensator

Low voltages continued to be reported at heavy load periods on one of the distribution feeders out of the Page Avenue substation of the Union Electric Company of Missouri in St. Louis. The compensator was juggled back and forth, but it was impossible to find any combination of resistance and reactance that would result in proper service pressure at both light and heavy load times. The line is a long one, with its normal load fairly well distributed along its length. But during heavy load periods the greater part of the load is concentrated at the far end of the line.

When the load was highest there still remained plenty of margin in the range of the induction regulator to bring the voltage up to normal. But the compensator, set for correct voltage with light load on the line, did not accurately simulate line conditions when the load was heavy, and in consequence the contact-making

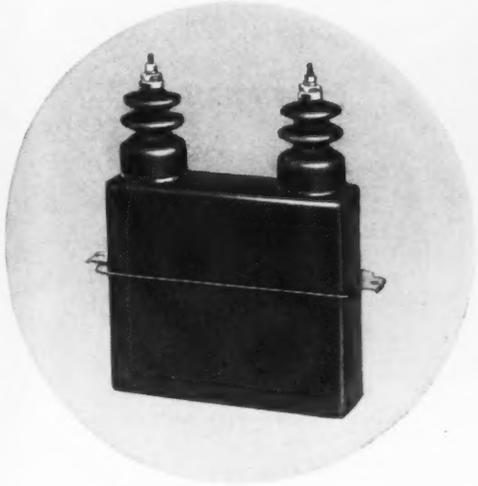


Elevations and section of transformer sling attachment

List of Material

Item No.	Code No.	Amt.	Description
1	AG624	1	Lag screw ½ x 4 in.
2	AG701	1	Round washer 9/16 in.
3	* A1008	2	Sling—8-ft. transformers 5 kva. and smaller
3	A1010	2	Sling—10-ft. transformers 7½ to 25 kva.
3	A1012	2	Sling—12-ft. transformers 37½ to 50 kva.
4	AG641	4	Staple, Copperweld 2 x ¼ in.

* ⅛ in.—7 x 7-in. preformed strand stainless steel cord. Breaking strength 1,700 lb.



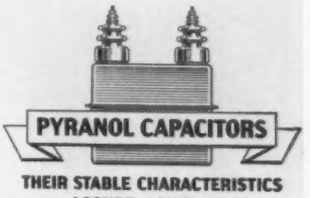
STERLING SILVER
$92\frac{50}{100}\%$ PURE

PYRANOL
CAPACITORS
$99\frac{85}{100}\%$ PERFORMANCE
RECORD

YOU can add Pyranol capacitors to your lines to release system capacity without adding to maintenance expenses. This has been proved by the operating record of all Pyranol capacitors installed since 1932, the year when Pyranol was introduced. That record is 99.85 per cent perfect.

Every part which goes into the capacitor is carefully checked. For example, the paper used as the solid dielectric is especially manufactured to our rigid specifications, with detailed inspection from pulp to finished rolls. All paper must pass exacting acceptance tests involving all of its physical, chemical and electrical characteristics. This helps us to be sure that the capacitor contains nothing which would impair these characteristics.

The record of these capacitors in actual service means that you can install them on your most vital circuits with absolute confidence. General Electric, Schenectady, N. Y.



GENERAL ELECTRIC

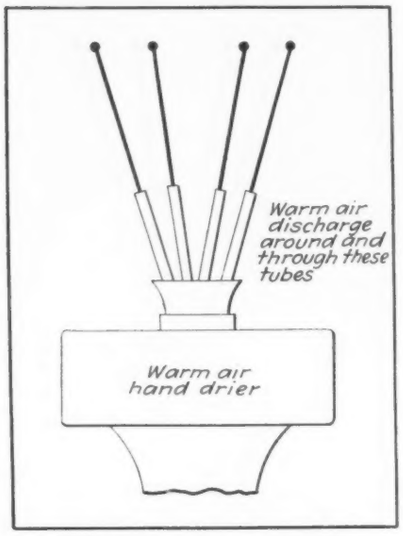
360-137

voltmeter did not boost the regulator above a certain point. A current overload relay was connected in the line to cut out a section of the series resistance in the circuit of the contact-making voltmeter when heavy load came on. This had the same effect on the voltmeter, and through it the regulator, as if the compensator setting had been changed to care for a concentrated load at the end of the line.

•

Uses Hand Drier to Dry Rubber Gloves

After rubber gloves have been subjected to the usual voltage test by immersion in water with a high potential gradient applied between in-



Rubber gloves dried quickly with warm air blower

side and outside they are usually hung up to dry. And, depending on humidity and temperature conditions of the surrounding air, they do dry very nicely in a shorter or longer time. But in the corner of the laboratory of the Milwaukee Electric Railway & Light Company where rubber goods are tested there is no clothesline for rubber gloves. Instead there is a warm air hand drier, from which the short downward pointing discharge elbow has been removed.

As is shown in the accompanying sketch, four tubes with extending wire fingers protrude from the opening in the blower housing. Except for the tubes inserted in it, the opening is not otherwise blocked, and thus, when the drier pedal is depressed, warm air blows up through and around the tubes. Gloves are placed over each of the tubes, supported by the wire extensions in the middle fingers. By this means four gloves can be dried very quickly, inside and out.

•

Calibrating 3-Phase Rotating Standards

By HARRY G. HAMMOND
Meter Standards Laboratory
Detroit Edison Company, Detroit, Mich.

All three phase rotating standards of the Detroit Edison Company are furnished with correction curves. These curves show the accuracy of the standard on loads ranging from 20 to 100 per cent of full load at 50, 70 and 100 per cent lagging power factor. Four points are checked to determine these curves, 20, 40, 70 and 90 per cent of rated current. The test is made on the 5-amp. coil at 120-volts. On the standards equipped with multiple current and voltage ranges the correction between ranges is considered negligible unless otherwise noted on the correction sheet. In addition to the curves mentioned above, accuracies are also given for 7.5 and 75 per cent load and at 86 per cent power factor lag. These are the loads obtained from the tester's load box. The standardization schedule calls for this test once every week:

Calibration routine

Part I—Limits of Error on Three-Phase Standards

(A) Balance of Elements—Separate elements are to check within 0.5 per cent of one another. The test is made at unity power factor, 75 per cent of rated current with potential circuits of both elements energized.

(B) Light Load (75 Per Cent Load)—Light load accuracy on separate elements is to be within 1 per cent of 75 per cent load accuracy of the element under test and within 1 per cent of the light load accuracy of the other element. In this test only one potential coil is energized.

(C) Inductive Load—Each element is checked at both 50 per cent leading and 50 per cent lagging power factor at 75 per cent of rated current. The accuracies at these two loads are to be within 0.5 per cent of one another. Both potential circuits are energized in this test.

(D) Heavy Load (75 Per Cent Rated Current)—The only heavy load adjustments are made with a three-phase load applied to the standard, the limits being that every point on the curve should be within 0.5 per cent of exact accuracy.

(E) Relation of Accuracy Limits to Correction Curves—The above-mentioned accuracy limits are set primarily as an aid in the initial calibration of the standard. Since, of course, it is desirable in all cases to keep the amount of correction in the final curves as small as possible, it has been found feasible at times to ignore calibration limits in order to achieve this end.

Part II—Standards Used in Testing Three-Phase Standards

Two single-phase rotating standards are used in testing of three-phase standards, one in the "X" phase and one in the "Z" phase. These two standards are set aside and used only for this one purpose, their potential coils are energized continuously. They are checked once a month against a laboratory standard wattmeter and also corrected for the errors known to exist in the wattmeter. This monthly test consists of the following curves taken on the 5-amp. coil.

100 per cent power factor—Points checked 100-250-400-600 watts.

86 per cent power factor lag—Points checked 100-200-350-500 watts.

86 per cent power factor lead—Points checked 100-200-350-500 watts.

50 per cent power factor lag—Points checked 75-150-225 watts.

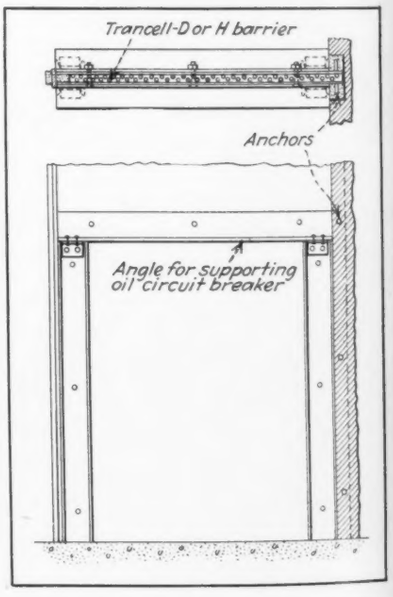
50 per cent power factor lead checked only at 225 watts.

26 per cent power factor lag—Points checked 25-50-75-100-150 watts.

This group of power factors represents the power factors on the separate phases when 100-70-50 and 86 per cent three-phase power factors are applied to the three-phase standards. In the same way that the wattmeter corrections are applied to the single-phase standards, so the correction of the single-phase standards is applied to the three-phase standards. No accuracy limits are set for the single-phase standards, the adjustments being so made as to result in small corrections when the two are used together in the three-phase tests.

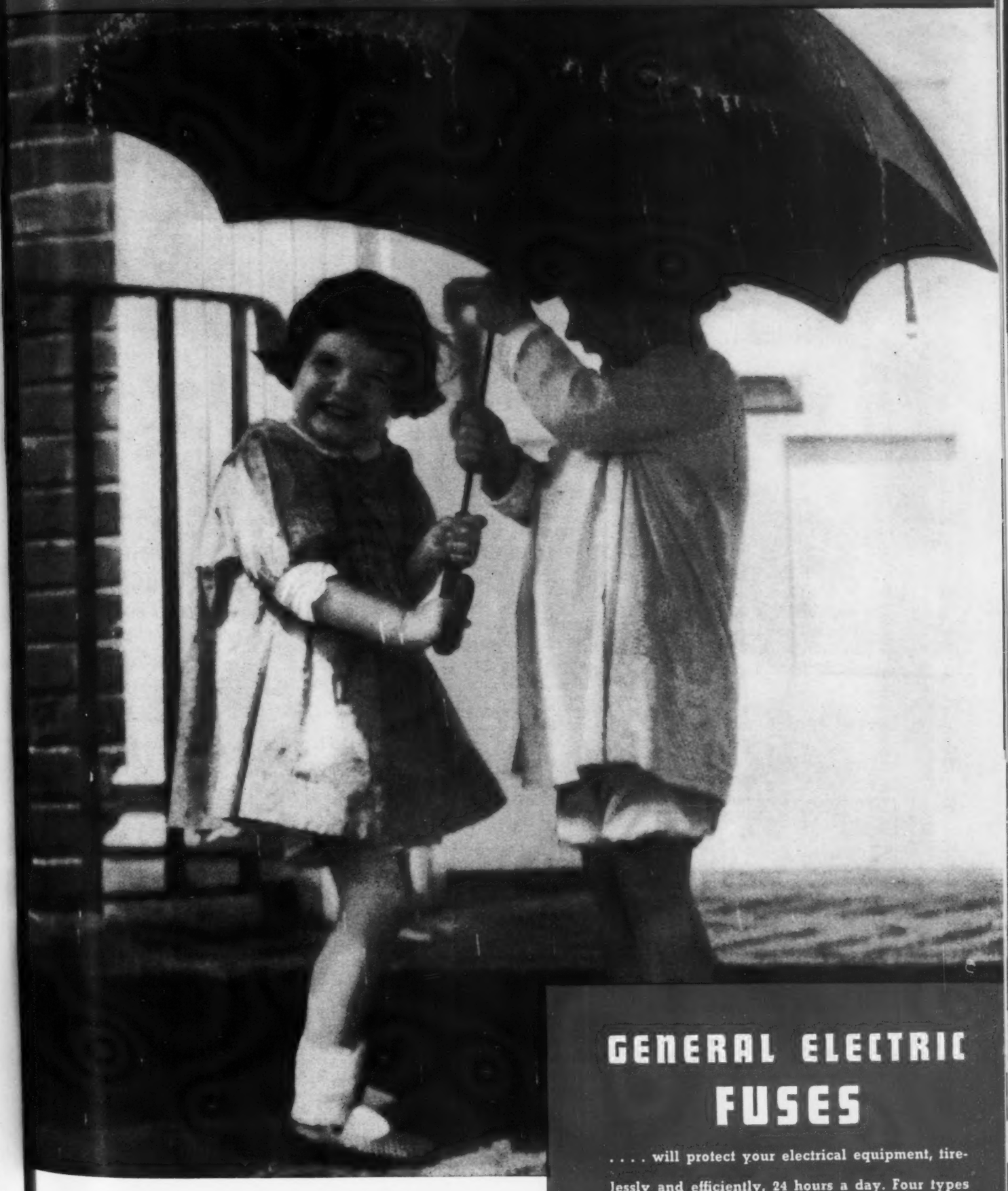
•

CIRCUIT BREAKER MOUNTING



A mounting suggested by Johns-Manville, Inc., for supporting oil circuit breakers on angle irons bolted to isolating barriers. Alternate methods of anchoring the barriers to the substation wall are shown in an earlier issue (ELECTRICAL WORLD, January 29, page 62).

PROTECTION



GENERAL ELECTRIC FUSES

. . . . will protect your electrical equipment, tirelessly and efficiently, 24 hours a day. Four types are available. For further information, write Section CDW-8163, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

GENERAL ELECTRIC

New ENGINEERING IDEAS

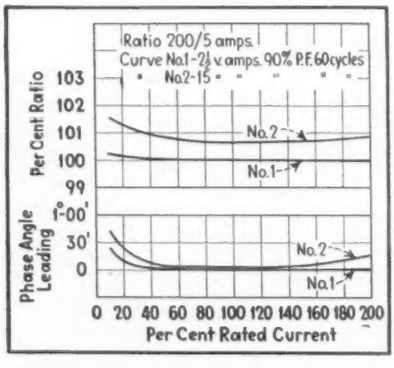
Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Current Transformer Has Wide Load Range

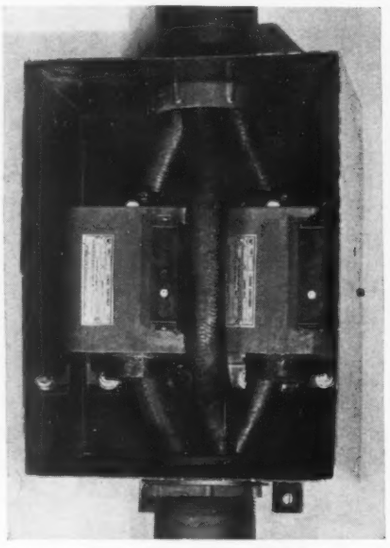
By B. V. MARTIN
Transformer Division, Westinghouse Electric & Manufacturing Company, Sharon, Pa.

A new through-type current transformer design having sufficient accuracy for billing both at light loads and overloads now permits full advantage to be taken of the available long range meters that are good for 300 per cent overload continuously. This transformer is especially adaptable to small commercial loads such as garages, churches, small theaters, schools, clubs and other establishments having low average load and occasional high, short-time peaks, because of its ability to handle the wide range of load accurately.

Performance characteristics for this type transformer, known as type FW, are shown in the accompanying illustration. A ring type "Hipernik" core is used that is provided with an opening for the primary conductor instead of a primary bar. The secondary is wound on a ring-type core and is slipped into a Micarta tube with an insulating tube through the primary opening. Sheet steel end caps close the ends and the whole is varnished.



New through-type current transformer accurate over wide range of loads



Compact current transformer design permits mounting in small space

Insulation is provided by a Micarta tube through the primary opening of sufficient thickness and length to meet the requirements of each voltage rating.

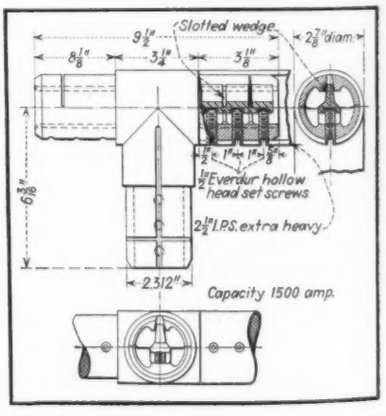
With two transformers the entire range from 20 to 1,200 amp. can be metered and still be within three-tenths of 1 per cent of accuracy, as shown in the accompanying curves. This effects a reduction in cost due to stocking only two sizes where previously all different sizes had to be stocked to cover the same range. Also, a through-type current transformer without the primary conductor is cheaper than the standard wound type on ratios 400/5 and higher.

A self-contained metering unit is obtained by the use of this transformer in a box as small as 14 in. long, 10 in. wide and 9 in. deep, with a type CS meter and CS socket mounted directly on the cover.

•

New Bus Connectors Expand From Within

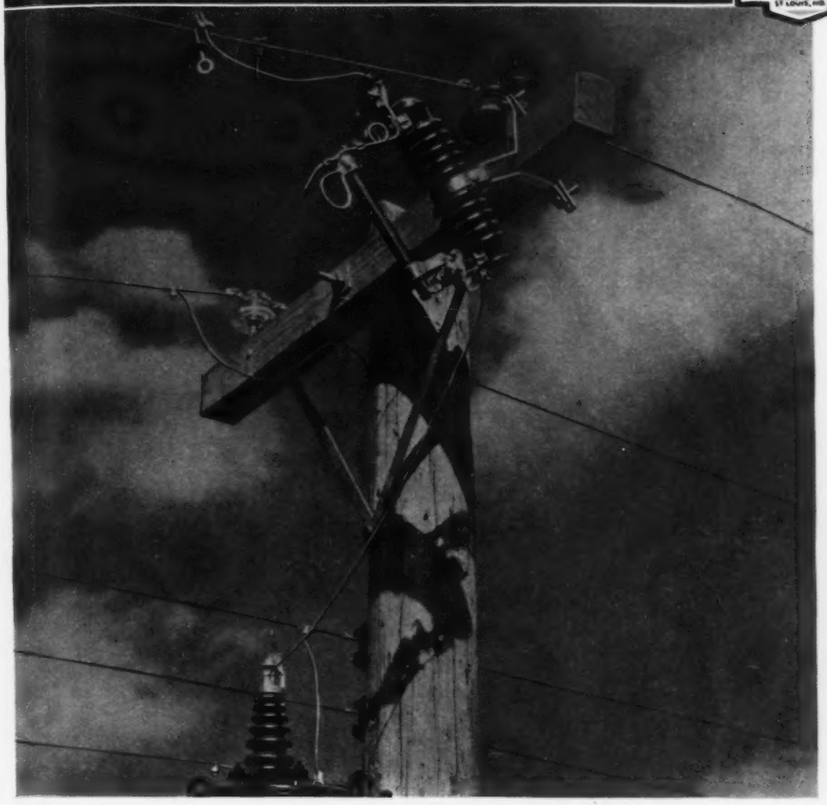
A wedge and screw combination acting from within radially expands the split sections of a new internal expanding connector, bringing its surfaces into intimate contact under high pressure with the inner surfaces of tubular bus. The resulting smooth joint can be completely covered with tubular insulation, a desirable feature in high-capacity generator bus installations.



Internal expanding connectors permit resulting smooth joints to be covered with tubular insulation

Sections of the cast copper alloy

ASSURE GREATER CONTINUITY OF SERVICE WITH JAMES R KEARNEY CORPORATION ST LOUIS, MO. *Products*



"Ten thousand of those trip outs in service and—not a single cartridge burn-out."

Kearney Trip Outs Hold Down Costs

—and You Won't Be Troubled with Cartridge Burn-Outs on Low Capacity Faults . . . .

Avoid improper functioning of your switches by using Kearney factory tested QUIK-ACTION FITALL FUSE LINKS. . . . Packed in handy cartons. Specify these positive performing links on your next order.

CARTRIDGE burn-outs were causing troublesome outages—unnecessary patrols were becoming a serious item in operating costs. . . . Then this company, like many others, decided to try Kearney Trip Outs—10,000 of them went into service the first year. . . . And not one cartridge burn-out among those 10,000 switches. . . . Today Kearney Trip Outs are specified as standard.

Careful research and sound engineering design account for the outstanding performance of these switches . . . point pressure contacts, coordination of moving parts, positive ejection of the fuse link after it has melted and separated—these are factors which Kearney engineers studied and perfected in the production of these Trip Outs.

You can prove to your own satisfaction that Kearney Trip Outs are really exceptional—just test them any way you see fit. . . . Then you'll realize that you can hold down operating costs and eliminate a lot of troubles with cartridge burn-outs on low capacity faults by installing Kearney Trip Outs. . . . Speak to a Kearney representative, or write for details . . . today.

JAMES R. KEARNEY CORPORATION

4224-42 CLAYTON AVE. – SAINT LOUIS, MO.

Standardize with

KEARNEY

Products

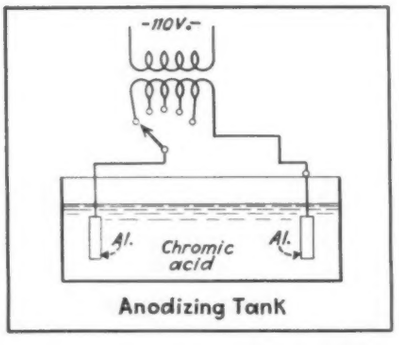
connector that are to fit inside the bus are machined to size, split longitudinally and slotted transversely to allow the expanding section to conform to the inside surface of the bus. Set-screw actuated wedges adjusted through holes in the bus exert expanding force on these split sections by virtue of the combined mechanical advantage of the screw and wedge. The wedges, which are several inches long, are deeply slotted in a transverse direction to make them self-aligning and to allow the sections of each wedge thus formed to act separately. Since the shoulder between the cast and the machined portions of the connector is the same height as the thickness of the copper bus being joined a smooth joint is produced.

Tests conducted by the Memco Engineering & Manufacturing Company, maker of this connector, indicate that in operation the bus temperature is equal to or greater than the temperature of the connectors.

•

New A.C. Process Plates Aluminum

Aside from conquering a recalcitrant metal, a new electrochemical process for plating aluminum introduced by Krome-Alume, Inc., Lockport, N. Y., also is designed to reduce the plating of aluminum to a point where it costs no more than ordinary plating. It involves no special equipment and at the same time is said to produce a durable covering.



Electrochemical process for plating aluminum uses alternating current

Preparation of the aluminum for plating by this method, developed by W. J. Travers, Buffalo, involves only the building up of an anodic oxide film in a bath of chromic acid or other suitable reagent. In the case of large scale production a 15-kva. transformer, with its secondary tapped to provide 5, 10, 15, 20, 25, 30, 35 and 40 volts, is employed. When a large number of surfaces are to be anodized a very low voltage is used to start the process. From 5, the voltage is worked up in a minute to 40. Naturally as the anodic film is created greater resistance is placed in the path of the current. A fully developed anodic film requires about ten minutes, at which time the resistance of the circuit reaches a very high point.

From the anodizing tank the articles to be plated are placed in an alkaline solution, such as sodium cyanide, the purpose of which is to reduce or modify the anodic film previously prepared. This is a very brief process, and after rinsing the article is ready to be placed in standard plating solutions and plated with standard current densities and voltages.

The process, which has been available for but a short time, is being used for electrical, aviation, medical and photographic parts and in some instances to reduce wear on moving surfaces.

• • •

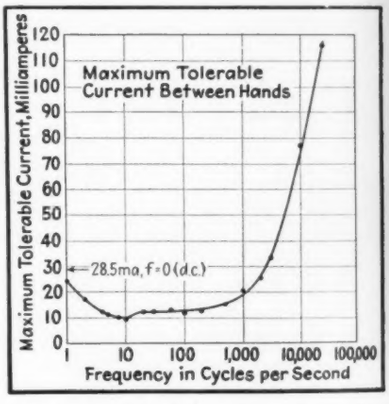
Study Shock Effects on Muscular Control

By CHARLES F. DALZIEL
Department of Electrical Engineering, University of California, Berkeley

Experiments recently conducted at the University of California in an effort to determine the limit of voluntary muscular control or simply the "let-go-current" of men subjected to electric shock indicate that this value, for 60 cycles, is in the neighborhood of 12.5 milliamperes. This current causing involuntary muscular control should be regarded, in the author's opinion, as the maximum current to which man should be subjected, since release from higher currents is problematical, and higher currents may affect the respiratory muscles and stop breathing during the shock.

To increase confidence and reduce detrimental psychological factors during the tests the maximum tolerable current was determined first. Subjects placed their hands or one hand and one foot on two metal disks. A potentiometer rheostat, energized from a 110-volt, 60-cycle source, was varied until the subject was satisfied that he could withstand no greater sensation. In every case the subject interrupted the circuit of his own accord by raising his hand from the electrodes. Average maximum current between hands of 81 recorded tests on 56 men was 13.9 milliamperes, the maximum current was 22 milliamperes and the average current between hand and one foot of eighteen tests on fifteen men was 13.5 milliamperes.

In determining the "let-go-current" the subjects placed one hand on the flat metal disk and with the other grasped and released a No. 10 gage copper wire. Average maximum current of 55 tests on 42 men was 12.6 milliamperes, and one subject released 18 milliamperes. The men were 20 to 40 years of age. There appeared to be no marked difference between wet and dry hands, experiments having been made with hands wet from perspiration, water, salt and weak acid solution.



Maximum tolerable current from electric shock varies widely with frequency

Characteristic curve for one person.

The effect of frequency on the maximum tolerable current for the author is shown in the accompanying curve. Values for frequency below 60 cycles were obtained from an alternator driven at low speeds. High frequency values were obtained by amplifying the output of a vacuum tube oscillator. Due to good agreement of all values at 60 cycles it was assumed that average data of the group would have given a similar response.

LEADERSHIP: When the vast majority of the companies in any industry express an overwhelming preference for any product it is well to look for the reasons. Copper and Copperweld-Copper leadership in rural line construction is not accidental. Here are two of the reasons for this growing preference.

RUGGEDNESS: The durability of Copper, always the standard conductor material, plus the high strength and mechanical stability of Copperweld.

SIMPLICITY: Handled, strung, spliced and tied in the same as all-copper conductors. The three-wire vibration-correcting design makes special fittings or devices unnecessary. Copper and Copperweld-Copper Conductors are tied in with simple annealed tie wires—just one piece of wire at each insulator.

The trend is to longer spans and Copperweld-Copper Conductors. Specify them and be assured of dependable rural lines.

COPPER CONDUCTORS

MANUFACTURED AND SOLD BY

KENNECOTT WIRE AND CABLE CO. — PHELPS DODGE COPPER PRODUCTS CORP

Industrial ELECTRIFICATION

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Electric Furnaces Hold to Close Limits

In preparing cast special alloys for the airplane industry it is imperative that temperatures be held within exceedingly close limits. To do this type of work, therefore, the Aluminum Alloy Casting Company, Los Angeles, required a furnace that would bring metal to pouring temperature without overheating and without disturbing alloy analysis or causing excessive oxidation.

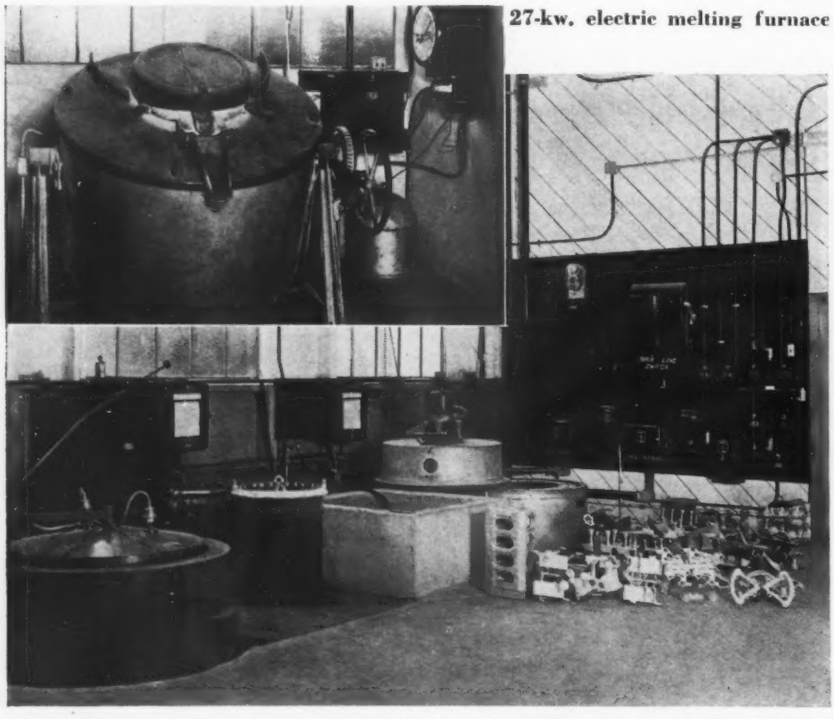
To meet this need a 27-kw., 250-lb. American Electric Furnace Company melting furnace was installed. This unit is capable of bringing a cold charge to 1,290 deg. F. in four hours. Subsequent charges can be brought to temperature in 1¾ hours. For heat treating the castings a 30-kw. and a 40-kw. furnace were installed. These were of General Electric and Leeds & Northrup manufacture and were pit type units, capacity of which depended on the casting.

Time controlled, the casting furnace turns on at 5 a.m., has the first charge ready by 9 a.m. and heats three subsequent charges during the working day. Thus daily consumption in this unit is 250 kw.-hr., and in terms of metal output ¼ kw.-hr. per lb.

Heat treating takes place at 750 deg. for annealing, 960 deg. for hardening. Since overheating by only a few degrees is sufficient to ruin the casting, temperature is closely controlled by a recording electrical pyrometer during the nineteen hours a casting is in the furnace. During this period power is on about half the time.

Thus with an average charge of 300 lb. power consumption would be 1.25 kw.-hr. per pound.

At industrial rates prevalent along the West Coast power for casting plus heat treating approximates 5 to 10 per cent the cost of metal itself.



27-kw. electric melting furnace

Recording pyrometers maintain 750 deg. temperature of special airplane castings in pit-type electric furnaces during 19-hour heat-treating period

•

Laundry Saves Coal With Heat Reclaimer

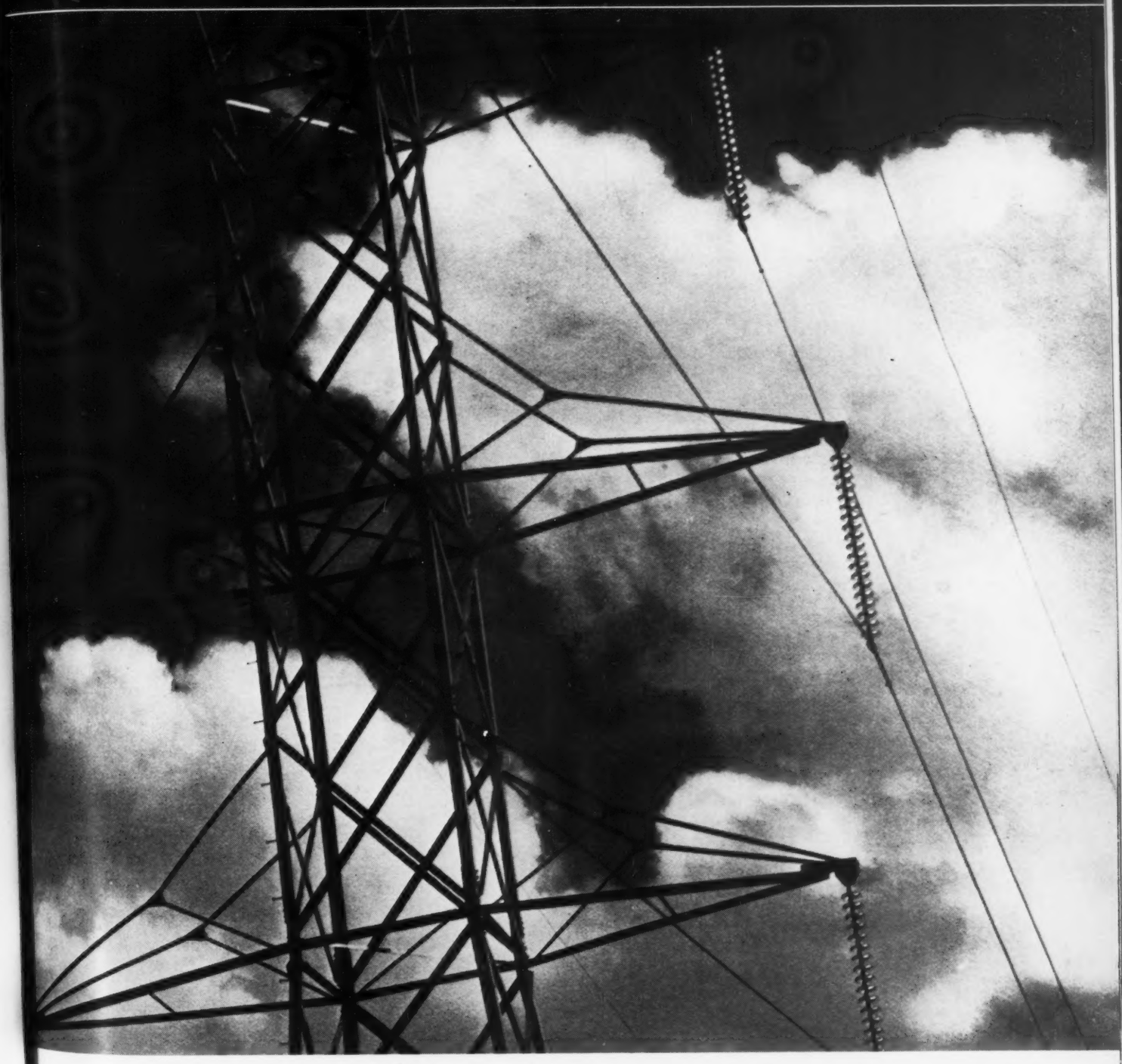
By J. V. GAYNOR
Nebraska Power Company, Omaha, Neb.

Consolidation of two smaller laundries into the larger plant in Omaha's new Guarantee Laundry provided opportunity to utilize the advantages of purchased power and modern heat exchanger equipment as recommended by local utility power representatives.

The exchanger, constructed locally, extracts heat from the used wash water before it is discharged to the sewer. Temperature of incoming fresh water is raised thereby approximately 40 deg. F. Outside dimensions of the concrete tank of the exchanger are 5x5x25 ft. Six sections of nine tubes each of 1-in. copper pipe in standard 20-ft. lengths terminated in 3-in. galvanized iron pipe headers constitute the heat exchanger proper.

Condensate from mangles, presses, tumblers, etc., is taken to the hot water supply tank on the roof of the building. At this point all flash steam is condensed in a conventional spray heater. Hot water temperature of

154,000 volts—on its way to beat an egg!



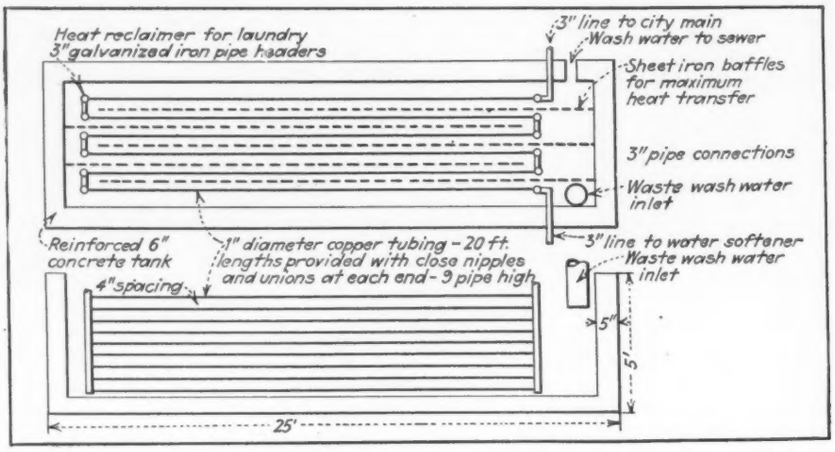
THERE it goes! A cataract of power on its way to village, city and farm, frequently from a source hundreds of miles away.

Soon it will be "stepped down" to do a thousand and one jobs, from welding together a streamlined train, to beating an egg for Johnny's custard...and for pennies, too! For since 1920 the average cost of electricity for household use has dropped from 7½¢ to 4⅓¢ per kilowatt hour. From the day Corning blew a thin glass bubble for Edison's first incandescent lamp, Corning has played a useful part in the advance of electric service.

Today, because of their high electrical values and greater mechanical strength, Pyrex power insulators are used in high voltage transmission lines. "Pyrex" brand glass in lightning arresters guards against current interruptions. It is even used in the fuses that protect wiring against "overload".

Corning knows glass, for glass is Corning's only business. Glass objects of art, handmade by Steuben craftsmen, examples of which are in the Metropolitan Museum of Art. Glass for the world's largest telescope mirror. Glass in the form of miles of sturdy crystal pipelines for food and chemical industries. Glass as Pyrex Ovenware and Flameware, and in slender, cottony fibres for fireproof house insulation! Glass research in America began at Corning. Write for free copy of "Corning Glass Works presents..." Corning Glass Works, Corning, N. Y.

CORNING
means
Research in Glass


Heat reclaimer for laundry
3" galvanized iron pipe headers
3" line to city main
Wash water to sewer
Sheet iron baffles for maximum heat transfer
3" pipe connections
Waste wash water inlet
Reinforced 6" concrete tank
1" diameter copper tubing - 20 ft. lengths provided with close nipples and unions at each end - 9 pipe high
4" spacing
3" line to water softener
Waste wash water inlet
5'
25'

Heat reclaimer easily built

160 deg. F. is maintained with only an occasional live steam boost.

Except for draining of the tank and washing down the tubes with hot water once a week, the reclaimer requires no attention. With an average of 75,000 gal. of water per day the coal saving is estimated at more than 300 tons a year. During the winter, with incoming water temperatures running as low as 33 deg. F., a 20 per cent saving of salt is effected due to higher water temperature through the water softener.

Installation of steam engine generator capacity for the laundry's 150-kva. demand would have required considerable initial investment, with proportionate fixed charges. Adding in the usual operating costs chargeable to steam engine operation was sufficient to convince the management that purchased electric power provided the lowest over-all cost.

SAVINGS RETURN 30% ON CAPACITOR COST

One of the more significant wastes attending the use of electricity in industrial plants is that of low power factor. Operating data from the records of a furniture factory operating 2,100 hours per year illustrate results obtainable by installing power-factor corrective equipment.

Monthly maximum 15-minute demand, kw.	57
Annual power consumption, kw.-hrs.	110,000
Average power factor *before* correction, per cent	65 to 69
Capacitors installed, kva.	50
Average power factor *after* correaction, per cent	98½ to 99
Annual savings returned 29% on the investment.	

Capacitor unit was installed in air compressor room and connected to main distribution panel.—LEE C. SHELAIN, Central Illinois Electric & Gas Company, Rockford, Ill.

Energy Minor Part of Product Value

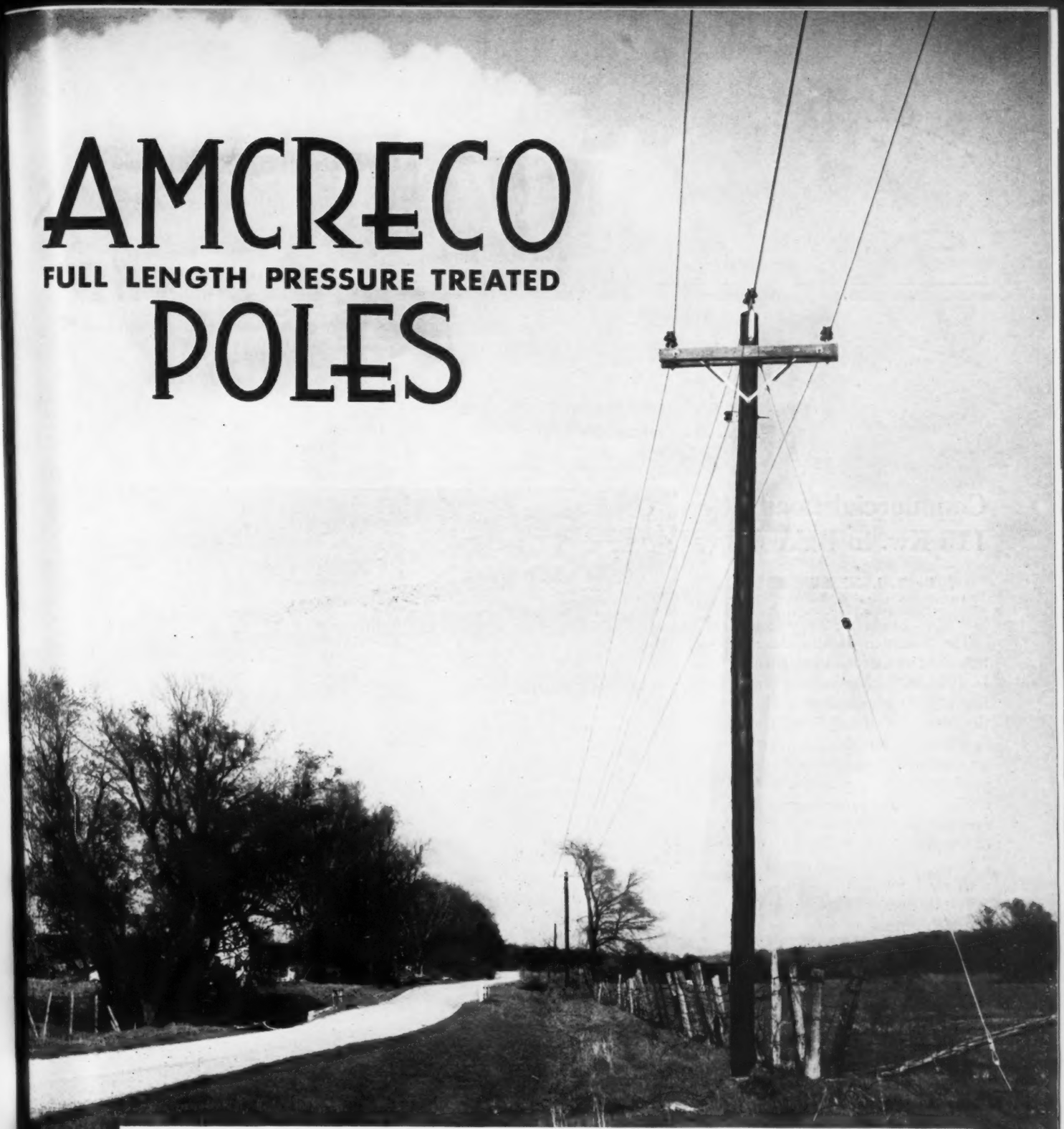
The accompanying table gives the cost of industrial electric energy expressed as a per cent of the value of products manufactured by fifteen basic American industries. These data are based upon information furnished the Edison Electric Institute by the U. S. Board of Labor Statistics from data secured when making the U. S. Census of Manufactures of 1929.

Information given the E.E.I. showed the cost of purchased electricity to those factories buying power as compared to the total value of products of all factories, some of which generate their own electricity. The figure for the cost of purchased electricity is adjusted in the following manner:

Assume shirt factories were shown to spend $4,000,000 for purchased electricity while the value of all shirts produced was shown as $100,000,000. However, only 40,000 hp. of motors out of a total of 45,000 hp. were shown as being driven by purchased power, the remaining 5,000 being driven by generators operated by the shirt manufacturers. The cost of purchased power shown in the census figure was raised in the ratio of 45,000 hp. to 40,000 hp. or to $4,500,000, the equivalent of 4.5 per cent of the total value of the shirts manufactured.

Cost of Electricity Used by Industries

Industry	Ratio of Cost of Electric Energy to Value of Product, per Cent: Main Group	Sub-Group	Sub-Group
All industries	1.3	...	...
Food and kindred products	0.9	...	...
Ice cream	...	2.0	...
Ice, manufactured	...	14.8	...
Meat packing	...	0.3	...
Textiles and their products	1.4	...	...
Artificial leather	...	0.6	...
Dyeing and finishing textiles	...	1.6	...
Hat and cap material, men's	...	0.8	...
Wearing apparel group	...	...	0.3
Clothing (except work clothing)	...	...	0.3
Men's, youths' and boys', etc.	...	...	0.3
Clothing, men's buttonholes	...	...	0.4
Clothing, workmen's, etc.	...	...	0.4
Clothing, women's, not elsewhere classified	...	...	0.3
Collars, men's	...	...	0.4
Furnishing goods, men's, not elsewhere classified	...	...	0.4
Gloves and mittens, cloth, etc.	...	...	0.5
Handkerchiefs	...	...	0.5
Shirts	...	...	4.5
Suspenders, garters, etc.	...	...	0.2
Wool group	...	1.5	...
Woolen goods	...	...	1.7
Worsted goods	...	...	1.8
Carpets and rugs, other than rag	...	...	0.7
Paper and allied products	4.5	...	...
Paper and pulp (wood and other fiber)	...	7.0	...
Converted paper products	...	0.7	...
Boxes, paper	...	...	0.7
Envelopes	...	...	0.6
Labels and tags	...	...	0.6
Printing, publishing	0.6	...	...
Rubber products	1.3	...	...
Stone, clay and glass products	3.7	...	...
Cement	...	9.9	...
Clay products (other than pottery) and non-clay refractories	...	3.6	...
Minerals and earth, ground or otherwise treated	...	.5	...
Non-ferrous metals and their products	0.9	...	...
Aluminum manufactures	...	0.9	...
Non-ferrous metal alloys and products, not including aluminum products	...	1.1	...
Machinery, not including transportation equipment	0.8	...	...
Foundry and machine-shop products	...	1.0	...
Transportation equipment, air, land, water	1.0	...	...
Motor vehicle bodies and motor vehicle parts	...	0.8	...
Railroad repair shops	1.2	...	...



AMCRECO

FULL LENGTH PRESSURE TREATED POLES

SERVICE interruptions cause a loss in revenue and good will. For more than 30 years, AmCreCo Pressure Creosoted Pine Poles have helped insure customer satisfaction by maintaining line security. High initial strength is retained long after the line has earned its retirement.

An unusual length of serviceable life is expected from AmCreCo poles. Why? Because their reputation has been built on such service. All creosoted poles are not backed by a fine reputation—so, when poles are considered, make sure your choice is sound. Ask to consult an AmCreCo engineer.

AMERICAN CREOSOTING COMPANY
INCORPORATED

COLONIAL CREOSOTING COMPANY INCORPORATED

AMCRECO LOWRY PROCESS CREOSOTED WOOD

GEORGIA CREOSOTING COMPANY INCORPORATED

ADDRESS INQUIRIES TO CHICAGO, ILL., OR LOUISVILLE, KY.

Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

Commercial Load of 115 Kw. in Bakeshop

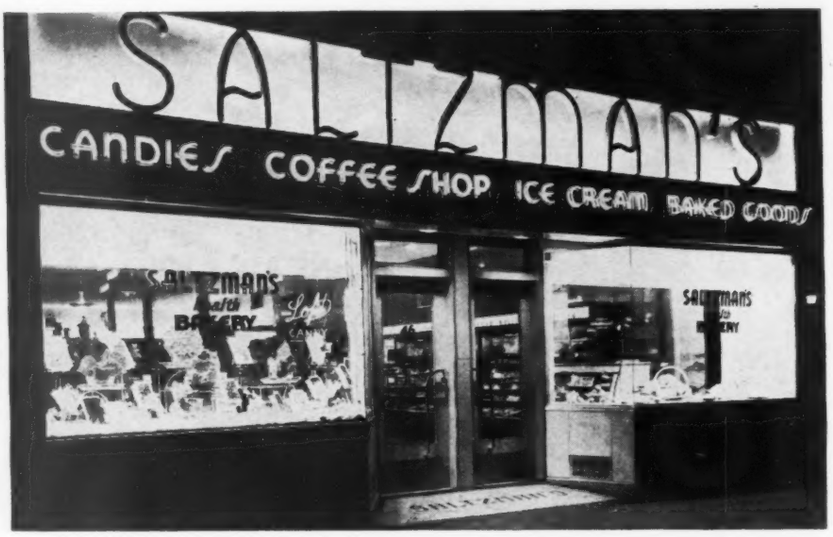
By T. I. MESSENGER
Buffalo, Niagara & Eastern Power Corporation, Buffalo, N. Y.

The Saltzman Health Bakery attests the fact that modernization pays. In 1934 Mr. Saltzman purchased his first electric oven and with it learned the advantage of individual temperature control on each deck and the importance of this feature to varied production. Today in the new bakery he has six separate ovens on three foundations, permitting a flexibility of temperature and a variety of production which was not obtainable with his former equipment.

The three large electric ovens, two of which have a capacity of eighteen pans each in two decks, the third having a capacity of eight pans in two decks, enable the bakers to produce a much wider variety simultaneously. The ovens are kept heated practically 24 hours a day. It is not necessary to shift the pans in order to get an evenness of heat, nor is it necessary to keep all of the equipment heated up when the production does not warrant it.

Whereas a 40-pan fuel-fired oven was used in the old bakery, supplemented by an eight-pan electric oven, in the new shop the only time that the full 46 pans capacity is called on is during the night hours when they are producing bread. This provides a 24-kw. block, which during the daytime is used by the restaurant and soda grill in cooking and back bar equipment.

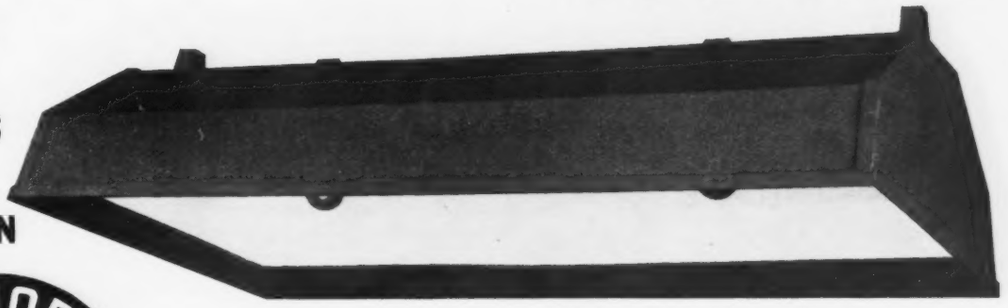
In the kitchen an electric range and meat grill handle the major part



This bakery on the lines of Buffalo, Niagara & Eastern Power Corporation has 94 kw. of cooking and baking load, 12 hp. of motor equipment (including refrigeration) and 12 kw. of lighting load

NEW (HIGH EFFICIENCY) CANOPY

INDIVIDUAL UNIT OR CONTINUOUS LENGTH INSTALLATION



CANOPY fostoria LOCALITE

Trade Mark Registered
U.S. Pat No. 2,029,532

PROVIDES WELL DIFFUSED EVENLY DISTRIBUTED

Localized Illumination

Specifications

MODEL WC CANOPY

OVERALL LENGTH—Multiples of 2½ feet over 5 foot minimum. With or without ends.

OVERALL WIDTH—36 inches.

DEPTH OF CANOPY—12½ inches

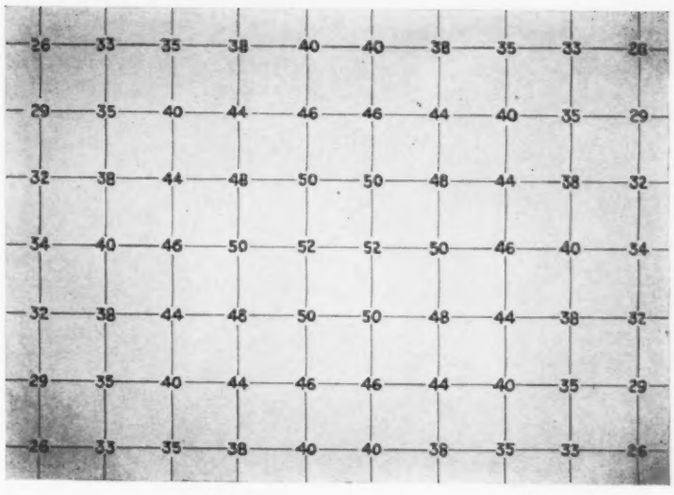
LAMPS—Recommendation, one 150 or 200 watt clear lamp with Alzac cup or Silvered Bowl lamp for each 2½ feet of canopy length.

FITTINGS—Medium screw base porcelain socket every 2½ feet attached to roof of canopy. Each socket wired through standard outlet box for easy installation. Mounting straps attached to roof of canopy approximately 5 feet apart. Shipped without ends unless specifically ordered. Ends attached at factory.

FINISH—Special baked matte white enamel inside. Baked wrinkle gray outside.

NET WEIGHT—57 lbs. per 5 ft. of length.

SHIPPING WEIGHT—117 lbs. per 5 ft. of length.



* FOOT CANDLE EFFICIENCY CHART (5 ft. unit with ends)

	2—150 Watt Lamps	2—200 Watt Lamps
Average foot candles	33	39
Maximum foot candles	43	52
Minimum foot candles	20	26

* Readings taken at intersections of 8" squares on 4 ft. x 6 ft. table, 48" below canopy edge. Note even light distribution.

Again, the progressive developments of Fostoria engineers bring to industry a new cost-saving opportunity through improved localized lighting equipment. The new WC Canopy Localite provides new high efficiency in diffused illumination evenly distributed over large working areas. Designed for continuous length (2½ ft. multiples, 5 ft. minimum) or individual unit installation, it is ideally adaptable to any length inspection line or production operation. Note the wide even spread of effective lighting illustrated by the foot candle chart above. This well diffused high intensity illumination greatly increases the visibility of workers on tasks where seeing ability governs the speed and quality of production. Improved worker efficiency results in cost savings far beyond the low investment required for this modern Localite installation. Request further details, now. A Fostoria representative is at your service to work out any special localized lighting problem you may have.

THE FOSTORIA PRESSED STEEL CORP., FOSTORIA, OHIO

Specialized Engineered Units for Every Localized Lighting Need . . .

of the work, whereas in the back bar shop short-order equipment, such as waffle bakers, toasters, soup cookers, coffee makers, food warmers and fudge warmers, handle a large part of the short-order and sandwich work.

The cooking and baking load in the kitchen consists of the following appliances:

	Kw.
2 NA72 Edison bakeovens—24 kw. each	48
1 NA56 Edison bakeoven	10.8
1 KA16 Edison fry kettle	12
1 Standard model 818A range	11.45
1 Griswold model 811 meat grill	2.25
2 Cory coffee makers, Model 375, each, 1.98 kw	3.96
1 Griswold CFW1 food warmer	1.250
1 Griswold 310A12 waffle baker	1.500
1 4CA toaster	2.45
1 Fudge warmer	0.425
Total	94.085

In addition to the above heating load, there is a total of 12.5 hp. miscellaneous motor equipment, which includes refrigeration, mixers, etc., and a lighting load of 12 kw.

The new Saltzman's shop is indeed modern in every respect; its lighting is so designed that there is no glare even on the glass display cases. Yet the intensity of light is sufficient to bring up all of the merchandise for sale and is so designed that it calls particular attention to each section.

Inside the shop the shadow box signs on each of the wall cases indicate various types of merchandise for sale in that section of the store. The store lighting itself is semi-indirect for general illumination in the front of the store, some of the fixtures being dropped below the circular air conditioning grills; louvered, recessed lights over the counters provide high-intensity illumination without glare in the selling areas. The tea room section of the store is lighted from a cove about 7 ft. from the floor surrounding the entire eating area.

•

Load Building Basis for Salesmen's Pay

In the commission schedule for field salesmen in the 1938 sales program of the Public Service Company of Northern Illinois emphasis rests more on the load-building value of merchandise sold and less on its retail price.

For instance, the commissions on I.E.S. floor lamps are three fixed amounts, the smallest for lamps of less than 300 watts, the next larger for lamps with 100-, 200-, 300-watt bulbs and the largest commission on lamps of more than 300 watts. The salesman is not tempted to take time in the effort to sell a large, ornate lamp when he might quickly close the sale of a lower priced one of equal wattage and of equal serviceability to the purchaser. Also, the schedule differentiates between appliances according to their customer acceptance and dealer representation, the commission on a large, expensive refrigerator being the same as on a frill-less range sold for much less money. Thus it is throughout the whole schedule; every stated item has a fixed commission in dollars and cents irrespective of sale price.

To provide increasing incentive, salesmen receive rising bonuses based on their commissions. A commission of $50 earns a bonus of 10 per cent and the bonus increases one-half of 1 per cent for every $5 commission over $50. A salesman who earns $100 in commissions receives a bonus of 15 per cent, or $15. A commission of $200 gets 25 per cent, or $50. This geometrical progression of rising bonus percentage on higher commissions works out very attractively to the salesman who works hard at his job.

In addition to commission and bonus each salesman receives a base salary comfortably above the sociologist's estimate of a minimum wage, of which so much is heard these days. The salary is not stated as a commission minimum, but is separate and distinct. The commission, large or small as it may be on whatever sales are made by him, is added to the salesman's base salary. Naturally under this set-up the salesman who earns no commission will not draw a base salary very long. And, conversely, the salesman is assured that loss of time by reason of illness or other good cause will not reduce his income to an uncomfortably small amount as would be the case if he worked solely on commission.

•

55 Foot-Candles for Radio Production

By J. V. GAYNOR
Illuminating Engineering Division
Commonwealth Edison Company

How systematic promotion, engineering surveys and modern sales methods are advancing the Commonwealth Edison Company, Chicago, towards its goal of "an efficient lighting system in every Chicago factory" is shown by the accompanying picture of the assembly table of the Belmont Radio Corporation. Local lighting units were completely eliminated by this high-intensity lighting system. The units shown are (300-500-watt) glassteel diffusers on approximately 5-ft. centers and wired for 500-watt capacity. Well-diffused light of 55 ft.-candles is obtained on the working surface. Employees see faster and more accurately, without eye strain.

Assembly lines of Belmont Radio Corporation in Chicago employ 55 ft.-candles from 500-watt diffusing fixtures spaced 5 ft. apart

This installation proved so satisfactory that the relighting program was continued throughout the factory and offices of this company. H. Tendick, production manager of the Belmont company, writes:

"We assure you that this modern lighting system has aided us appreciably in maintaining our increased production schedule. This has been accomplished with a decrease in rejects per unit of production."

THIS

Greater leakage distance means **OUTAGE-FREE** *performance*

EVEN under severe weather conditions the greater leakage distance of HEMINGRAY Insulators, series-600, assures outage-free performance. . . This modern design, coupled with tough HEMINGRAY electrical glass and the greater mechanical strength provided by the brass bushing, means long, efficient service under either light or heavy loading conditions.

Specify series-600 for lower initial and over-all costs. Send for samples. Test them mechanically. Learn their greater service advantages. Owens-Illinois Glass Company, "FIRST IN GLASS", Hemingray Division, Muncie, Indiana.

● *World's largest manufacturers of glass containers; and producers of INSULUX Glass Block, DUST-STOP Replacement-Type Air Filters, FIBERGLAS Insulating Wool, Insulating Blankets and Filter Cloth.*

3 SIZES

TYPE 660 . . . FOR VOLTAGES UP TO 8,000
TYPE 670 . . . FOR VOLTAGES UP TO 10,000
TYPE 680 . . . FOR VOLTAGES UP TO 15,000
Handle most PRIMARY line requirements

● **Actual size of HEMINGRAY Glass Insulator . . . Type 680**

● **Actual length of leakage distance—Type 680 HEMINGRAY**

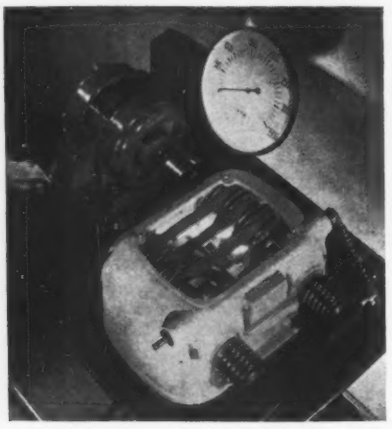
FOR MODERN POWER LINE INSULATION

Order **HEMINGRAY Glass INSULATORS**

New EQUIPMENT AVAILABLE

Variable Speed Transmission

To meet the demand in a great variety of industries for a compact, economical and flexible speed-changing device this company has developed a new unit, em-



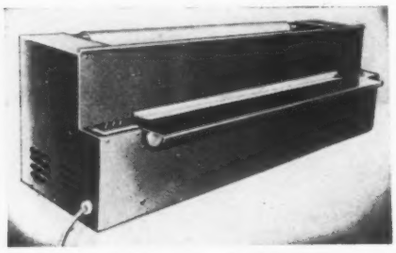
"Vari-Pitch Speed Changer"; demonstration model, with 1,800-r.p.m. direct-connected motor and "finger-tip" electric remote control; line covers range from 1 to 33 hp., speed range of 3.75 to 1, running approximately between 300 and 3,600 r.p.m. **Allis-Chalmers Mfg. Co.**, Milwaukee, Wis.

ploying its variable-pitch pulley sheaves. Designed for direct connection to a standard motor, the device consists of a pair of shafts on which are mounted two deep-grooved "Vari-Pitch" sheaves, adjusted through a worm and worm-wheel combination, which is operated either manually by a hand wheel or electrically through a fractional-horsepower motor controlled through a forward and reverse push button.

•

Printing Machine

New printing machine for blueprints or black-and-white prints is of the con-



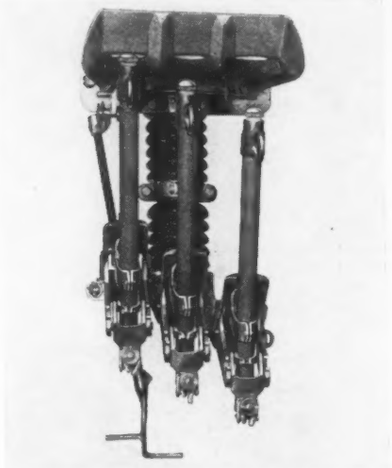
Model 4 printer; direct drive through roller chain to drive roll; wired for 110 volts, a.c. or d.c.; for prints up to and including 42 in. in width. **Charles Bruning Co., Inc.**, 102 Reade St., New York, N. Y.

tinuous type, tracings and paper being carried on a heavy, endless canvas band past a curved contact glass, inside of which are mounted two new style, long-life mercury vapor tubes, which provide the illumination for exposing the print. Because no resistance is used in the power circuit, these mercury vapor tubes are said to consume 100 watts less current per tube than the previous model. Greater light output is also said to be gained, each tube producing 19.5 lumens per watt, compared with 14 lumens for the older type. Printing speed is said to be 50 per cent faster than previous model.

•

Reclosing Fuse Switches

Shown here is a new rural line dropout reclosing "Fuswitch" in operating position, with the left-hand fuseholder carrying the load. Should the fuse in this holder melt the holder drops and the hinged lid moves down to make contact with the center fuseholder, reclosing the

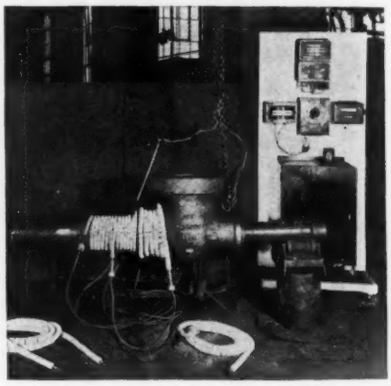


Rural line dropout reclosing "Fuswitch"; fused with flexible tail fuse links from 1 to 50 amp. inclusive; can be furnished to handle 1 to 100-amp. links, and for 2-cycle reclosure; 5 to 15-kv. units. **W. N. Matthews Corp.**, St. Louis, Mo.

circuit in 40 cycles. Should the fuse in this holder melt the process is carried a step further, the hinged lid dropping to make contact with the right-hand fuseholder, again within 40 cycles. As the fuseholders drop down they are automatically roofed, preventing them from filling with rain water. Fuseholders are removed and replaced with standard ball-point hotstick, no special refusing sequence being necessary.

Stress-Relieving Heaters

Application of this company's recently developed coil-type, wrap-around stress-relieving heaters to a Series 1500 valve



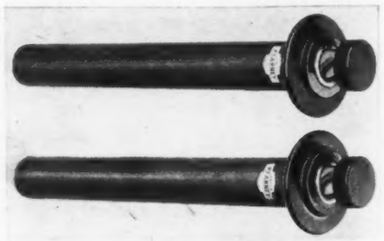
"Falcon" coil-type, wrap-around preheating and stress-relieving heaters. **H. O. Swoboda, Inc.**, New Brighton, Pa.

joint is illustrated here. When preheating during welding only the two outer coils are used; for stress relieving the third coil over the joint is added as shown. Automatic temperature control panel for controlling preheating and stress-relieving temperatures is also shown; panel can be supplied for single-point or multiple-point control. During preheating and stress-relieving operations, of course, heaters are covered with insulating blankets to minimize radiation losses.

•

Jumper Clamp

This newly developed mechanical jumper clamp in general follows the design of the other jumper clamps in the company's line. However, since it is expressly intended for handling higher voltages, Bakelite handles 15 in. long (as shown) and longer are used, to provide the operator not only maximum initial safety but also safety over an extended period of usage.



Jumper clamp; for main conductors of 250,000-circ. mil copper to No. 4/0 stranded copper jumper. **James R. Kearney Corp.**, St. Louis, Mo.

6 FEATURES

which Protect a

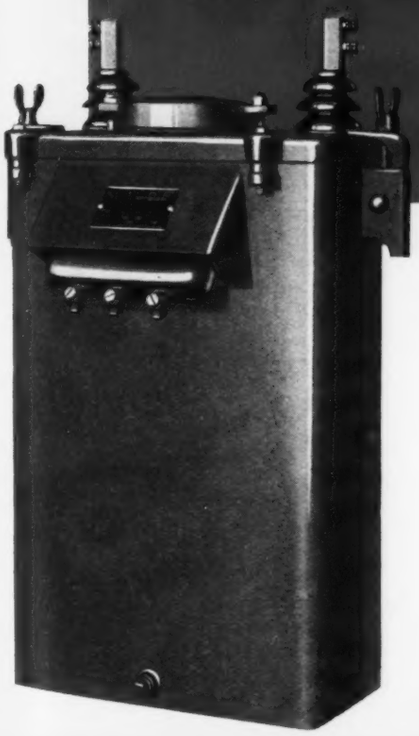
LONG TERM INVESTMENT

in

STANDARD

DISTRIBUTION

TRANSFORMERS



1. New primary bushing design which provides "Double Seal" gasket protection between porcelain and tank, and incorporates the solderless connector as an integral part of the bushing hardware.
2. Overhanging, steel pocket which protects secondary bushings from the weather and prevents damage to the porcelain when transformer is being shipped or stored in warehouse.
3. Neoprene gasket which makes the joint between the cover and tank oil tight and weather-proof.
4. Rugged, durable tank fabricated from 12 gauge steel on sizes 1½ to 15 KVA, and from 10 gauge steel on sizes 25 KVA and above.
5. Tough, oil-proof finish, consisting of three coats of blue-gray enamel which is flexible to the expansion and contraction of the tank metal under temperature changes.
6. High surge strength and good regulation.

FOR COMPLETE DESCRIPTION OF STANDARD DISTRIBUTION TRANSFORMERS WRITE FOR BULLETIN S-401

THE *Standard* TRANSFORMER COMPANY

141 DANA ST., WARREN, OHIO

Use DILECTO

when you need an insulating material to withstand moisture

Even when directly exposed to moisture or high humidity Dilecto, a laminated phenolic plastic material, retains its insulating properties and its mechanical accuracy. It is an ideal material for parts which must be electrically and mechanically stable.

Let us tell you more about Dilecto, how it is manufactured, about various grades in both paper and fabric, developed for specific electrical requirements. You'll find complete data in the Dilecto catalog. Write for your copy today.

CONTINENTAL-DIAMOND FIBRE COMPANY

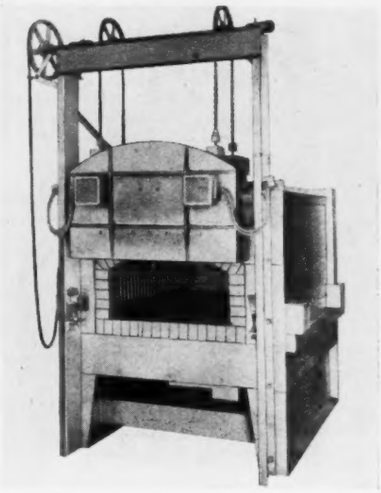
NEWARK, DELAWARE

Represented in Canada by

DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO

Electric Furnaces

Tubes of nickel-chromium replace the more conventional resistors in new high-temperature electric furnaces. When heated, the tubes act as individual stacks



"Lindberg" high-temperature furnaces; line includes box types, in ratings from 10 to 170 kw.; pot types, in ratings from 18 to 38 kw. **Lindberg Engineering Co.**, Chicago, Ill.

to create circulation within the furnace. Thus, it is claimed, furnace temperature is thoroughly equalized and, in addition, continual circulation insures a uniform gas analysis throughout the chamber when special atmospheres are used. Heat-dissipating surface of the "Tubulaire" elements, as they are called, is said to exceed greatly that of resistors.

•

Dead-End Clamp

Designed especially for hot line work, this new dead-end clamp for distribution lines is also suggested for use in dead-ending strain busses in low-voltage substations. Clamp is made of galvanized

Clamp No. 20282; for all conductors up to No. 4/0 copper; has loop for attaching comealong and can be used with rubber shield. **Locke Insulator Corp.**, Baltimore, Md.

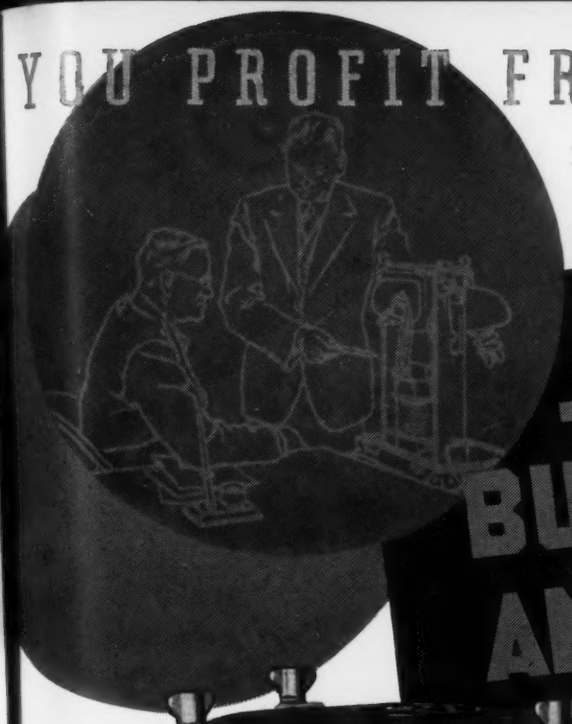
malleable iron, conductor being held by two galvanized steel keeper bolts. In line construction it is said to be unnecessary to remove these bolts completely from the clamps to insert the conductor, a feature that not only reduces number of loose parts the lineman has to handle but also helps speed up installation.

•

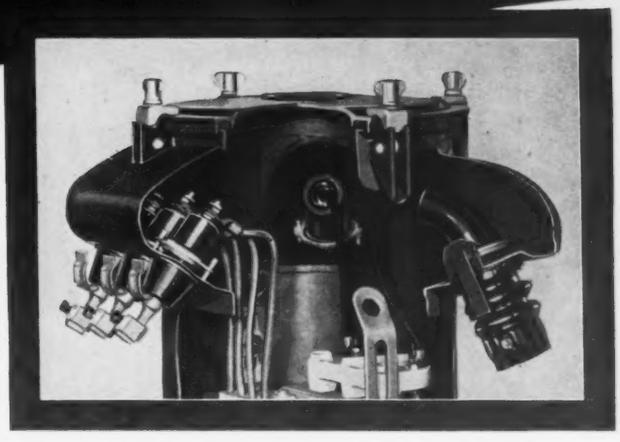
Safety Switch

This new low-capacity feeder safety switch has been designed to replace open-type knife switch installations in industrial plants and mines. Switch is of the quick-make, quick-break type, inclosed in a fireproof case to provide a safe means of disconnecting the circuit under load

YOU PROFIT FROM THIS ADVANTAGE



- - - - ELIMINATE BUSHING BREAKAGE AND OIL LEAKAGE



Haul L-M Transformers out on the job, hoist them up a pole, or handle them in the storeroom—you will not run the chance of damaging a bushing. The big overhanging pocket gives maximum protection against bushing breakage.

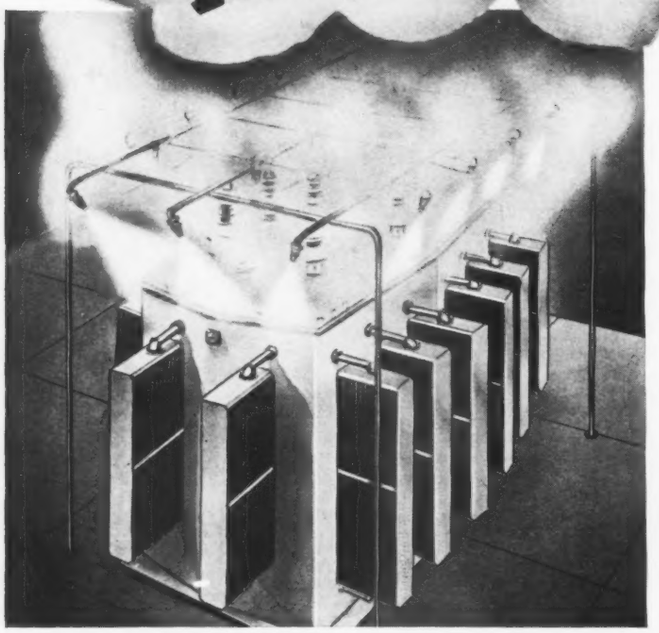
Oil will not syphon out and run down the leads — the internal bushing construction and the gaskets take care of that. And those gaskets that keep the oil in and moisture out are protected from the weather.

This bushing design is another of the many advantages you will find in L-M Distribution Transformers. Ask your L-M Representative or write Line Material Company, South Milwaukee, Wis.

L-M DISTRIBUTION TRANSFORMERS

ANNOUNCING

Kidde "FIRE-FOG" SYSTEM



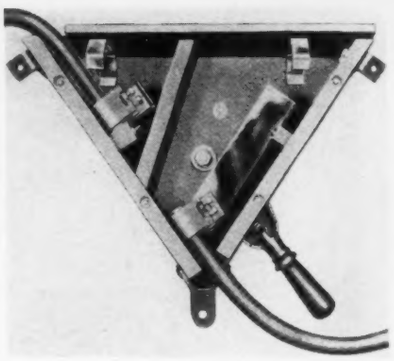
ENGINEERED FIRE PROTECTION FOR OUTDOOR TRANSFORMERS

Kidde FIRE-FOG is a *water spray system*, based on a new-type nozzle, advanced in design, highly efficient in operation.

Kidde FIRE-FOG will operate satisfactorily on as little as 40 lbs. water pressure. **Thus, an auxiliary pump is usually eliminated.**

Walter Kidde & Company engineering service as applied to LUX carbon-dioxide extinquishing systems, has proved valuable to public utility men everywhere. You will be interested to know of the extension of our organization's field of service to the application of water to outdoor oil-filled electrical equipment.

Walter Kidde & Company
30 West Street, Bloomfield, N. J.



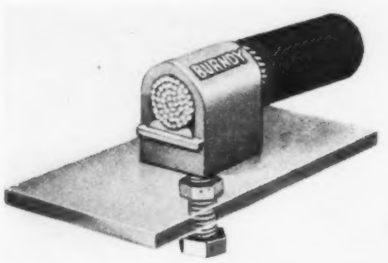
Low-capacity feeder safety switch for 250-600 volts, in 300- and 400-amp. sizes. **Ohio Brass Co.,** Mansfield, Ohio.

without danger to operator or damage to switch. Heavy rubber handle provides further protection.

•

Transformer Terminal

This clamp connector has been designed especially for terminating cables to the copper bars extending from each side of current transformers. Clamp consists of



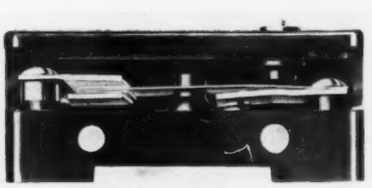
Type KPF connector. **Burndy Engineering Co., Inc.,** New York, N. Y.

cast copper body, through bottom section of which a hole is tapped. A ½-in. bolt passes through hole in the copper bar and into the tapped body hole, where it forces pressure bar against cable. Tightening the nut on the bolt clamps the joint to the bar. Clamp may be pivoted on bolt to permit cable tap-off at any angle.

•

Snap Switch

This new snap switch acts on the reverse cross-center principle; first you press the plunger, then it snaps. Total operating pressure required on the plunger is



"Mu-Switch." Sold by **Tobe Deutschmann Corp.,** Canton, Mass.

said to be four ounces; movement is less than 0.001 in. Supplied in black Bakelite, switch dimensions are 1 15/16 x 11/16 x 27/32 in. Switch will safely carry 10 amp., 110 volts a.c., on an inductive load of ½ hp.

•

Circuit Breaker Relay

Intended for low-voltage service up to 24 volts, this new relay with magnetic release is usable as an overload cutout.

SAVE

Time and Money With This *Electric* Buyers Reference

A wealth of handy buying information that will make your work easier is included in the 1938 Electrical Buyers Reference. If you want information on any electrical product or manufacturer, look first in this improved edition.

For Example:

Want to know who makes Switches? Just turn to the S's in this section and you will find a complete list of switch manufacturers plus descriptions of the individual makes in many cases.

Trying to locate a product with trade name "American"? A simple reference to the alphabetical tabulation of trade and company names (page 351) will locate the product for you immediately. Remember, if you want quick information on any Electrical Product or Manufacturer, look first in

ELECTRICAL BUYERS REFERENCE

★

Published Annually by

ELECTRICAL WORLD

330 WEST 42nd STREET ★ NEW YORK, N. Y.

A McGRAW-HILL PUBLICATION

Have you received your copy of this NEW **"MEGGER" CATALOG?**

If you are responsible for installing or maintaining electrical equipment, you will find valuable information in this new "Megger" Catalog. It tells just what the "Megger" instruments are and why "Megger" testing is such a convenient and practical way to detect trouble and forestall failure. And it describes the most complete line of instruments ever offered for testing insulation resistance.

Send for this Catalog and read the suggestions it contains for saving money by the use of "Megger" Insulation Testing Instruments.

Ask for Catalog 1550-W.

JAMES G. BIDDLE CO.

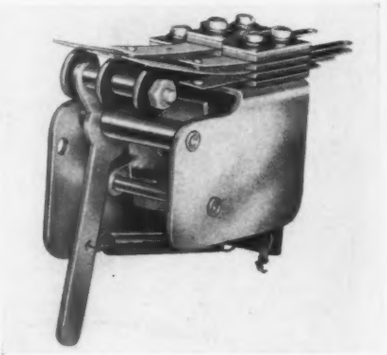
ELECTRICAL INSTRUMENTS

1211-13 ARCH STREET PHILADELPHIA, PA.

Other Biddle Specialties:

- **"Megger" Ground Testers**
- **"Megger" Direct-Reading Ohmmeters**
- **"Megger" Capacitance Meter**
- **"Ducter" Low Resistance Testing Sets**
- **"Dionic" Water Tester**
- **"Frahm" Vibrating-Reed Tachometers and Frequency Meters**
- **"Jagabi" Rheostats**
- **"Jagabi" Speed-Measuring Instruments**

a manual reset annunciator drop and an off-level indicator, in conjunction with a pendulum bob. Three contact stack mounting positions permit three operating switches at a single level. Where necessary, additional contact combinations can be added to any one of the three stacks, and relay can be used in multiple assemblies with a common reset arm.



Type B relay. **G.M. Laboratories,** Chicago, Ill.

•

Air-Conditioning Motors

Type RT polyphase motors; standard sizes 40 hp. and larger. **Wagner Electric Corp.,** St. Louis, Mo.

New motors for air-conditioning service are designed to have the desirable features of comparatively low starting current, high starting torque, satisfactory operating characteristics and good speed regulation. Unlike the double squirrel-cage type motors, the rotor in this motor is a primary member, carrying a winding which is connected to the line when the motor is operating. Secondary member is stator, carrying a short-circuited winding in addition to the secondary winding. Motor is said to have a locked torque of about twice full-load torque and a locked current from three to three and one-half times full-load current. In a previous announcement (ELECTRICAL WORLD, February 12, 1938) this motor was incorrectly said to have a locked torque of from three to three and one-half times full-load current.

•

Motor-Generator Set

Type YX-21 motor-generator set; rated 1½ kw. at 35 volts, weighs 330 lb. **Westinghouse Electric & Mfg. Co.,** East Pittsburgh, Pa.

Maintenance and power consumption are said to be reduced by this new motor-generator set for railway car battery charging. New scheme of control permits motor speed and generator field regulation. This improvement, together with others, is said to produce a set some one-third smaller and lighter than machines normally supplied for such service.

•

Push-Button Stations

Oil-proof push-button stations; flush-mounted, surface-mounted, momentary-contact and selector switch units included. **General Electric Co.,** Schenectady, N. Y.

New line of compact, standard-duty push-button stations has been designed to resist deteriorating action of oil and dirt encountered in machine-tool applications. Stations are provided with graphited packing ring between button proper and bushing, or oil guard, to prevent seepage of oil or grease into button mechanism.

TAYLOR

PHENOL FIBRE

VULCANIZED FIBRE

TAYLOR INSULATION

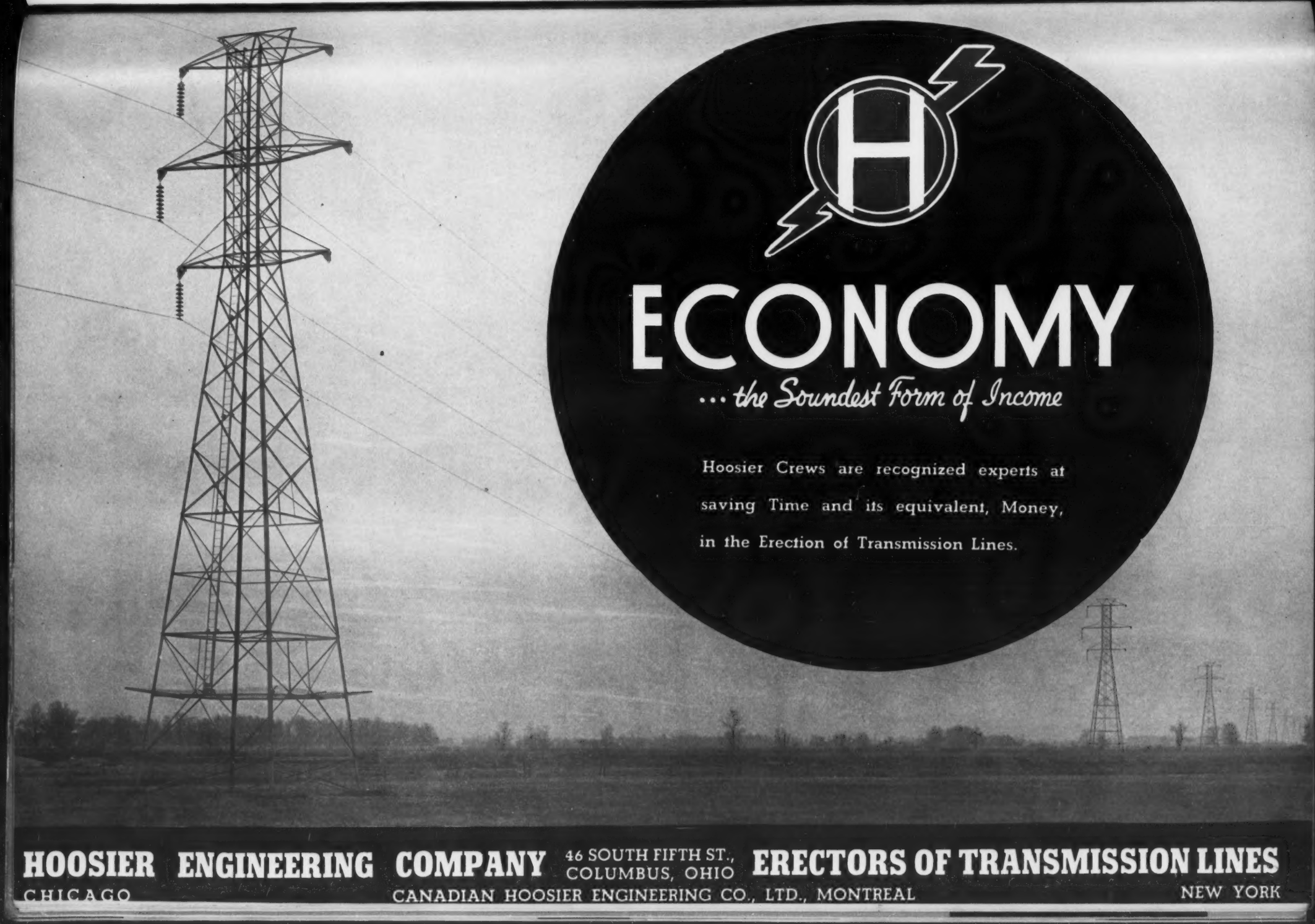
SILENT GEARS

TAYLOR

ESTABLISHED 1891

TAYLOR FIBRE COMPANY

NORRISTOWN, PA.


ECONOMY
... the Soundest Form of Income
Hoosier Crews are recognized experts at saving Time and its equivalent, Money, in the Erection of Transmission Lines.
HOOSIER ENGINEERING COMPANY
46 SOUTH FIFTH ST., COLUMBUS, OHIO
ERECTORS OF TRANSMISSION LINES
CHICAGO
CANADIAN HOOSIER ENGINEERING CO., LTD., MONTREAL
NEW YORK

STEEL TOWER • • • WOOD POLE LINE CONSTRUCTION
SWITCHING STRUCTURES • SUBSTATIONS • POWER HOUSES

CONSULT **SCHULMAN**

FOR POWER LINE REHABILITATION AND EXTENSIVE CONSTRUCTION PROJECTS

Highly experienced personnel—modern equipment for modern construction. Schulman Erection Specialists are immediately available for the most extensive projects and cooperate fully with you through every step of the way. They have the ability to erect lines in the quickest time and at the lowest possible cost to you.

Recent Projects Completed

Wilson-Norris Steel Tower Line—121 miles, Tennessee
Wheeler-Guntersville Steel Tower Line—65 miles, Alabama
Fort Peck Dredge Feeder Distribution System—Fort Peck, Montana

Now under construction

Skagit Steel Tower Transmission Line—116 miles, Washington State

A. S. SCHULMAN ELECTRIC COMPANY
537 S. Dearborn Street
CHICAGO, ILL.
FOUNDED 1890

Greenlee Hydraulic Tools for Bending and Pushing Pipe

Hydraulic Conduit and Pipe Benders

Much time and money can be saved by using Greenlee Hydraulic Tools for bending conduit and pipe. Not only do they do the work faster, but they make a better job of it with much less effort on the part of the workmen. They are simple to operate and easy to take to the job. No. 770, shown to the right, bends all sizes of conduit from 1¼" to 3". The larger size, No. 775, bends all sizes from 2½" to 4½". Attachments can be furnished for thin-wall steel conduit.

Ask Now for COMPLETE DETAILS

Hydraulic Pipe Pusher

With this hydraulic pusher, one man can stand in a comfortable position and send pipe under streets, sidewalks, lawns, etc., simply by pumping the handles. It saves money and makes it unnecessary to do extensive trenching. Because of its compact design and simple construction, it is easy to set up and move about. Capacity for pipe up to 4"

GREENLEE TOOL CO., 1705 Columbia Ave., ROCKFORD, ILL.

TECHNICAL BULLETINS

SURGE MEASUREMENTS—"Proposed Recommendations for Measurement of Surge Voltages and Currents" is the title of a recent pamphlet of the American Institute of Electrical Engineers, 33 West 39th Street, New York, N. Y. Recommended sphere gap calibration standards are also included. Recommendations were formulated in the attempt to develop a surge measurement standard from which could be developed technique for surge testing codes for apparatus and materials. Bibliography is included in treatise.

CONSULTING CHEMISTS—The Association of Consulting Chemists and Chemical Engineers, Inc., 50 East 41st Street, New York, N. Y., has issued the 1938 Directory of Association Members. In addition to the listing of the members, the directory includes valuable details about the work these consultants are especially prepared to undertake. Copies are available, without charge, from the association.

BUDGETARY ACCOUNTING—A comprehensive, illustrated book, "Budgetary Control Through Modernized Mechanical Methods," has been issued by the Burroughs Adding Machine Company, Detroit, Mich., to provide assistance in the promotion and improvement of budget control in governmental, educational, industrial and commercial accounting offices. Preparation of periodic operating reports is treated in the text, which uses double-page displays of accounting forms where possible.

ELECTRICAL STANDARDS—Two new electrical standards recently approved by the American Standards Association are C37.1 1937 and C37.2 1937. The first covers all relays directly associated with power switchgear. The second applies to both automatic and partially automatic generating stations and substations, whether attended or unattended. Service conditions, definitions of terms, ratings, temperature limitations, tests and device function numbers are discussed. Copies are available at 40 cents each, from the association headquarters, 29 West 39th Street, New York, N. Y.

CABLE OPERATION—Statistical data on the operation during 1936 of underground power systems of more than 7.5 kv. as reported to the transmission and distribution committee of the Edison Electric Institute by 59 power companies are contained in Publication No. E17 of the institute. Performance data for high-voltage cables, with detailed information on failures, feature the booklet. Copies are available from E.E.I. headquarters, 420 Lexington Avenue, New York, N. Y., priced at $1.50 to non-members in U. S.

ELECTRICAL ALLOYS—For users of wire, rod and strip in the electrical, chemical and mechanical fields, Alloy Metal Wire Company, Prospect Park, Pa. has issued a helpful handbook of information and data on alloys. In addition to listing description, application and price per pound of alloys, it contains wire data, range of uses, current temperature characteristics of wire, resistance and feet per pound.

GEAR BOOK—Philadelphia Gear Works, Philadelphia, has issued a 72-page "Gear Book" which differs from the ordinary catalog in that it includes some 38 pages of engineering data for the engineer, draftsman or other person concerned with the design, construction and operation of gears.

CONCENTRATION

WEBSTER defines *concentration* as a "simultaneous firing upon a common target, or bringing to a common center."

The entire resources of Cornell-Dubilier . . . its engineering experience, skill and ingenuity are concentrated on the building of dependable capacitors—and capacitors alone. To that end, this company has concentrated twenty-eight years of tireless effort . . . a lifetime of "firing" upon a common target.

And time has more than proven that in capacitors for power-factor correction, as in all branches of industry, "C-D" means more capacitor value per dollar expended. Literature on request at Dept. C26, 1032 Hamilton Blvd. South Plainfield, N.

UTILITIES ARE FINDING IN CORNELL-DUBILIER CAPACITORS THE ANSWER TO THE PROBLEM OF INCREASING SYSTEM CAPACITY ECONOMICALLY.

CORNELL-DUBILIER ELECTRIC MANUFACTURING CD EM

CORNELL-DUBILIER

WORLD'S OLDEST AND LARGEST MANUFACTURERS OF CAPACITORS EXCLUSIVELY

Capacitors for Power-Factor Correction

News ABOUT PEOPLE

L. E. Seekins Elected Head of Lowell Electric Light

Leon E. Seekins, vice-president and general manager of the Lowell (Mass.) Electric Light Corporation, has been elected president of that

utility, a subsidiary of the New England Power Association.

Following graduation from the University of Maine in 1913, he entered the Lowell company's employ as a meter tester, and in 1924 was promoted to be assistant to the general manager. From 1928-29 he was manager of the Cape Breton Electric Company, Ltd., Sydney, N. S., and then returned to New England to become vice-president and general manager of the Worcester Electric Light Company. Here he also served as manager of the central group of retail properties controlled by the New England Power Association.

In 1934 he assumed the duties of vice-president and general manager of the Lowell company and district manager of the northeastern group of Association retail properties located in Lowell, Lawrence, Amesbury and Arlington. In his new capacity he succeeds the late John A. Hunnewell.

•

► SIR HERBERT S. HOLT of Montreal, Canada, has been elected a director of the Consolidated Gas, Electric Light & Power Company of Baltimore to fill a vacancy on the board caused by the death of Alexander V. Drummond of London. Sir Herbert is a former director of the company.

•

Interstate Power Elects New Executive Officers

James F. Orr, formerly vice-president of the Central Illinois Public Service Company, Springfield, Ill., has been elected to the presidency of the Interstate Power Company, Dubuque, Iowa. At the same time Oscar Solberg was elected secretary and treasurer. These two new officers replace three resigned, T. T. Parker, president; Walter A. Horner, secretary, and Neill Richards, treasurer. The new officers were elected by a new group of directors, who themselves were elected at a recent stockholders' meeting. Interstate Power is controlled by Utilities Power & Light Corporation.

Mr. Orr's first connection with an electric utility was in the general office of the Idaho Oregon Light & Power Company. In 1921 he became sales manager of that company. Mr. Orr was appointed division manager of the Utah Power & Light Company in 1927, having charge of its Ogden division until the fall of 1930, when he was made commercial manager of the United Gas System with headquarters at Houston, Tex. This position he held until 1934, when he was elected vice-president of the Central Illinois Public Service Company.

In 1923 Mr. Orr served as chairman of the range committee of the N.E.L.A., which started the national electric range survey completed in 1926.

•

► C. W. MCMULLEN, assistant chief inspector, Frigidaire division, General Motors Corporation, has been appointed manager, standards division, to succeed Mr. McMullen, resigned. In his new position he becomes responsible for the maintenance of material and production quality in the Frigidaire plants.

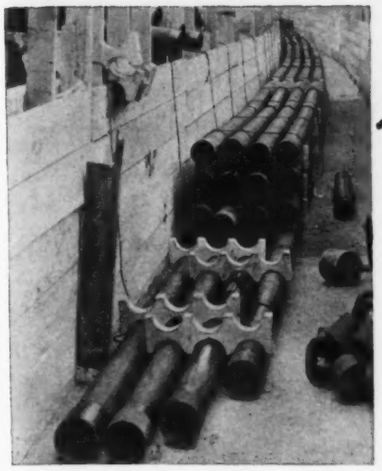
Slepian Associate Director of Research Laboratories

Joseph Slepian has been appointed associate director of the Westinghouse Research Laboratories at East Pittsburgh. Westinghouse Electric & Manufacturing Company has announced the appointment of Dr. Slepian as an associate to Director L. W. Chubb just 21 years after he started to work as an apprentice in the company's motor division.

Despite the fact that his formal education in higher mathematics included nothing about electrical engineering, Dr. Slepian has become one of the world's outstanding electrical engineers. His inventions helped make possible distribution of electric current at the present peak of 280,000 volts by providing new methods of breaking up electric arcs. He and other Westinghouse research engineers developed a

mercury-arc rectifier capable of passing only the forward-moving waves of alternating current, converting it to direct current.

Dr. Slepian was born in Boston and was graduated from Harvard in 1911. This was followed by graduate study abroad in integral and differential calculus, tensor analysis and integral equations. He is a member of the American Institute of Electrical Engineers, the American Mathematical So-



for 45 YEARS • • •

the cable-protection qualities of ORANGEBURG Standard Fibre Conduit have contributed towards lower maintenance costs, freedom from replacements and uninterrupted service. For use with concrete encasement, specify "Orangeburg Standard" and get proven quality and economy.

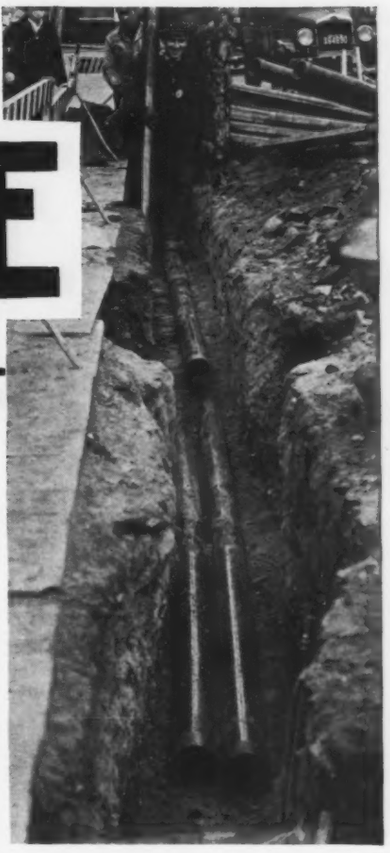
ORANGEBURG *standard* CONDUIT

AND *Now*

FOR USE WITHOUT CONCRETE ENCASEMENT

ORANGEBURG NOCRETE

THE NEW *Dual economy* CONDUIT



● Substantial savings in both initial material and installation costs are outstanding features of Orangeburg NOCRETE Conduit. It is about half the cost of metal pipe and less than non-metallic conduits of any comparable quality.

The same relative savings in installation costs which have distinguished Orangeburg Standard Conduit are available with this new super-sturdy duct; easier handling; easier cutting and tooling; adaptability to going around curves and obstructions; quick field assembly.

Wherever conditions suggest installation of conduit without concrete encasement . . . for service entrances, parkway and street lighting, signal systems, etc., specify Orangeburg NOCRETE Conduit and get not only immediate savings but future savings from years of maintenance-free service.

THE FIBRE CONDUIT COMPANY

Sales Agent **GRAYBAR ELECTRIC COMPANY, INC.**

ORANGEBURG Since 1893

Sales Office **292 MADISON AVENUE, N. Y.**

Sales Agent **GENERAL ELECTRIC SUPPLY CORP.**

ORANGEBURG

ciety, American Electrochemical Society and the American Association for the Advancement of Science.

•

Poey Leaves Consolidated to Join Greist Company

Members of the engineering staff of Consolidated Edison Company attended a testimonial dinner held recently at the Gramercy Park South Hotel, New York, tendered Charles D. Poey

on the occasion of his resignation from Consolidated Edison and his association with the Greist Manufacturing Company, New Haven, Conn.

Mr. Poey completed twenty years of service with Consolidated, culminating in the position of illuminating engineer and manager of the lighting bureau. He joined the Greist company in the newly created position of chief engineer of the illuminating division His work will include engineering development of lighting products for general and specialty use, contact with central power stations throughout the country and sales personnel training on lighting problems.

Mr. Poey is a member of the Illuminating Engineering Society, the American Institute of Electrical Engineers and the American Standards Association.

•

▶ HENRY I. HARRIMAN, formerly president of the New England Power Association, has been appointed a director of the Federal Reserve Bank of Boston. He is a past-chairman of the board of public trustees of the Boston Elevated Railway and past-president of the Boston Chamber of Commerce and of the United States Chamber of Commerce.

▶ W. T. GERMAN, lighting engineer for the Southern California Edison Company at Whittier, has received the company's 1937 W. L. Frost award for outstanding accomplishment in the commercial lighting field. The award is made annually. Mr. German's consistent high record of accomplishment during 1937 placed him first among the Edison Company's entire staff of lighting engineers. He has been employed by the company since 1929 and held various positions in the operating department of the company until 1935, when he was made a commercial lighting engineer in the Whittier district.

▶ J. HAROLD HAWKINS has been appointed consultant to the General Electric Home Bureau. Mr. Hawkins brings to his new position a wide editorial experience in the home building field.

▶ GEORGE W. WALKER has been retained as consulting designer by Nash-Kelvinator Corporation to collaborate with the designing engineers of both the automotive and refrigeration divisions of the corporation. Mr. Walker has been engaged in industrial designing for the past eight years.

▶ RICHARD N. NIGHTINGALE is connected with the Department of Public Utilities, City of Tacoma, Washington, which operates the municipal electric light, power, water and belt line railway systems, in the capacity of chief electrical engineer, not chief engineer, as reported in error in the March 5 issue of ELECTRICAL WORLD. Llewellyn Evans was superintendent of the light division until he left to join the TVA a few years ago, and Verne Kent, the present superintendent, was named to succeed him.

▶ CHARLES M. ROWLAND has been appointed sales manager for the commercial refrigeration section of the specialty appliance sales division of the appliance and merchandise department of the General Electric Company, Nela Park, Cleveland. Prior to this appointment Mr. Rowland had been commercial sales manager for the General Electric Supply Corporation of Cleveland, distributor of G.E. products. He first entered the refrigeration business in 1926 as a retail dealer.

▶ J. R. HANGO, who has been assistant electrical engineer for the Saguenay Power Company, Ltd., Arvida, Que., Canada, recently became power engineer for that company. Following a brief test course with the Canadian Westinghouse Company at Hamilton, Ont., Mr. Hango joined the Duke-Price Power Company, Ltd., which later became the Saguenay Power Company, as assistant to the electrical engineer. In 1930 he became assistant to the superintendent of operation, and in 1931 was appointed assistant electrical engineer.

▶ CLAYTON S. COGGESHALL has been made general assistant to R. B. Beale, manager of the turbine division, central station department of the General Electric Company. He was formerly manager of sales of the turbine division, Lynn River works. JOHN L. KERR, previously turbine specialist in the central district, has taken Mr. Coggeshall's place at Lynn, and ROBERT S. NEBLETT has become manager of sales, Schenectady section, turbine division. Mr. Coggeshall has been associated with General Electric since 1911, the year of his graduation from Cornell University. Mr. Kerr was formerly connected with General Electric's Chicago office, where he has been turbine specialist in the central district. Mr. Neblett has been connected with G.E. since 1923.

•

E. M. Graham Celebrates Twenty-fifth Anniversary

President Edward M. Graham of the Bangor Hydro-Electric Company was recently honored by members of the company's Quarter Century Club, who inducted him into that organization in commemoration of his 25 years of service with that utility. At the ceremony a suitably engraved watch, a gift of all the company's employees, was presented to him.

Mr. Graham has been in responsi-

ble direction of the company through his entire period of service, and during his administration it has been extended from a small enterprise in the Bangor, Ellsworth and Bar Harbor areas to one of the largest independent operating properties in New England, serving substantially all of eastern Maine.

•

▶ LEWIS H. BROWN, president and a director of the Johns-Manville Corporation, has been elected a director of the Bankers Trust Company.

▶ CARL F. MOWREY, local manager of the Central New York Power Corporation at Oswego, N. Y., is chairman of the Greater Oswego Exposition, to be held in the State Armory in that city April 6-9.

"Sure, I'm a TOUGH GUY ... sometimes!"

"I saw an advertisement run by The Associated Business Papers that pictured me as typical of the prospects that advertisers' salesmen classify as 'tough guys.' The ad went on to say that while I am tough when salesmen call, I am pretty regular when I am reading an A.B.P. publication. Well, I don't resent it a bit. With so many keen salesmen calling on me every day, I have to pretend to be hard-boiled most of the time.

"But you can be sure that I put aside that 'protective mask' when I am reading ELECTRICAL WORLD because that is where I go to keep in touch with trends and developments; for practical ideas suggested by an editor who is familiar with my business. I know that ELECTRICAL WORLD is written for *me*, not for its advertisers. Yet I read the ads, too, because I know that they are in there only because they have something to offer — not because they got editorial publicity.

"I pay cold cash for my subscription to ELECTRICAL WORLD and you can bet I wouldn't do it unless I get my money's worth."

Manufacturing AND MARKETS

General Motors Plans Air Conditioner Unit

A completely new type of unit air conditioner for residential, office, hotel, hospital and similar uses has been announced by General Motors' Delco-Frigidaire Conditioning Division.

Production of the new unit has started and the unit will be introduced to the public early in April. The unit will market for $399.50 completely installed.

The new unit looks much like a console radio cabinet. It has fingertip dial control, is portable and requires no plumbing and no electrical or other installation work except the connection of the power circuit and the fitting of an adjustable window section.

•

General Cable Operations Lower in First Quarter

First-quarter operations of the General Cable Corporation are considerably below the 1937 period, D. R. G. Palmer, president, said at the recent annual meeting of stockholders. He added that it was normally a slow period and operations were about in line with the trend in the capital goods industries.

One reason for the slackened business is that the utilities still are timid about buying in any large quantities, he said, but this attitude is not confined to utilities, it applies to virtually all other users of capital goods.

•

Business Prospects Better, Says Square D President

F. W. Magin, president of Square D Company, told stockholders at the recent annual meeting that the company had earned a small profit in both January and February and hoped to do better in March. The 15-cent dividend declared March 2, he said, was based on expectations that first quarter earnings would amount to at least that much. "Prospects for business now seem to be a little better, and we hope to obtain a good volume of sales in the second half-year," Mr. Magin stated. Volume in January and February was about 25 per cent under the similar months of 1937, he said.

•

Corporate Earnings Reported for 1937

Among the electrical manufacturing companies that have recently issued earnings statements covering operations in 1937 are the following:

WAGNER ELECTRIC—Net profit, after $94,605 provision for surtax, $1,620,043, equal to $4.14 a share on 391,385 shares of $15 par common stock, against $1,372,376, or $3.50 a common share, in 1936.

CURTIS LIGHTING—Net loss of parent company only was $44,702, compared to net profit in 1936 of $1,585. The wholly owned subsidiary, Curtis Lighting of Canada, Lt., had a net profit in 1937 of $18,732, against one of $11,304 in 1936. Curtis Lighting of Europe, S. A., in which the company owns 50½ per cent interest, had $1,483 net profit last year, compared to a loss of $20,000 in 1936.

RELIANCE ELECTRIC & ENGINEERING—And subsidiaries, net income after surtax, $390,772, equal to $2.61 each on 150,000 common shares, against $366,182, or $2.44 a share in 1936.

MANNING, BOWMAN—Net earnings for 1937, $25,745, compared with $49,020 in 1936. Sales increased 17 per cent over 1936, but wages and materials costs increased substantially.

CENTURY ELECTRIC—Net income $327,978, equal to 72 cents a share on 453,250 capital shares, against $338,648, or 75 cents a share in 1936.

•

Washer Shipments Increase

Factory shipments of household washing machines in January totalled 72,611 compared to 55,843 in December and 121,754 in January, 1937, reports J. R. Bohnen, executive secretary of the American Washing Machine Manufacturers' Association. Household ironing machines shipped in January totalled 8,967 compared to 9,180 in December and 15,894 in January, 1937.

Announce Reductions in Prices of Lamps

A reduction averaging 17.3 per cent in the list prices of incandescent lamps, effective April 1, was announced this week by the General Electric Company and Westinghouse Lamp Division of the Westinghouse Electric & Manufacturing Company. Affected by the price change are lamps in the 75 to 500-watt range.

In making this announcement David S. Youngholm, vice-president of the Westinghouse Electric & Manufacturing Company, said: "Increased demand for higher wattage lamps both for home and industrial use, together with improvements in engineering and manufacturing efficiency, makes it possible to pass these reductions on to the users of Mazda lamps."

Gerard Swope, General Electric president, pointed out that, in addition to being lower in price, as a result of continued scientific research, lamps are giving considerably more light for the current they consume than was produced by corresponding lamps of the past. This recent price reduction brings present average net prices of large Mazda lamps approximately 70 per cent below those of 1921, Mr. Swope said.

•

Supply Awards Made by Federal Boards

Secretary of the Interior Harold L. Ickes has announced the award of two contracts for electrical conductor for use in construction of transmission lines for the Kendrick federal reclamation project in Wyoming, for a total cost of $436,516, delivered, to the Anaconda Wire & Cable Company and the Aluminum Company of America. The contracts cover the following: Anaconda, shipping from Cheyenne, Wyo., 2,300,000 ft. of copper conductor, $253,185; 871,200 ft. of hollow, hard-drawn, bare copper conductor, $95,760, and Aluminum Company, ship-

ping from Massena, N. Y., 528,000 ft. of No. 1 steel-reinforced, bare aluminum conductor, $12,612, and 1,267,200 ft. of No. 4/0 steel-reinforced, bare aluminum, stranded conductor, $74,957.

Among other contracts recently placed by federal agencies are the following:

General Electric Company, contract for 20,000/40,000-kva. outdoor-type, three-phase regulators for installation in power substation at North Memphis, Tenn., TVA, $23,496; Moloney Electric, transformers for the same substation, $21,435 each.

General Cable Corporation, War, cable and reels, $27,735.

Phelps Dodge Copper Products Corporation, British American tube division, Navy, tubes, condenser, $52,384; Habirshaw Cable and Wire Division, TVA, insulated wire and cable, $21,363.

General Electric Company, Navy, turbo-generator sets, $525,970; aircraft tachometers, $14,000.

American Brass Company, Navy, condenser tubes, $16,198.

International Nickel Company, Navy, copper nickel alloy, $198,602. War, copper nickel alloy, $46,342.

Board of Public Utilities, Kansas City, Kan., has awarded a contract to the Okonite Company, New York, N. Y., for 15,000 ft. of three-conductor stranded Type H cable, at $30,195. Another award for 90,000 ft. of 5-in. fiber conduit, with tampered fittings, has been made to the Continental Electric Company, Kansas City, Mo., at $14,400.

•

More Trade Pacts in View

The reciprocal trade agreement between the United States and Czechoslovakia was signed March 7 to become provisionally effective on April 16. Reports from Washington indicate that conversations are now in progress with a view to developing reciprocal trade agreements with Australia and Argentina.

•

Will Vote on Stock Change

Stockholders of Cutler-Hammer, Inc., at their annual meeting on March 28 will consider adopting resolutions rescinding action heretofore taken by the stockholders at the special meeting held last September, providing for the creation of 25,000 shares of preferred stock. The company has recently announced the moving of its Cincinnati office to the American Building, Central Parkway at Walnut.

New York Metal Prices

	Mar. 15, 1938 Cents per Pound	Mar. 23, 1938 Cents per Pound
Copper electrolytic	10.00*	10.00*
Lead Am. S. & R. price	4.50	4.50
Antimony	13.75	13.75
Nickel ingot	35.00	35.00
Zinc spot	4.60	4.60
Tin Straits	41.75	41.00
Aluminum, 99 per cent.	20.00	20.00

* Delivered Connecticut Valley.

• HOLOPHANE •

Specialized **LIGHTING** *for*

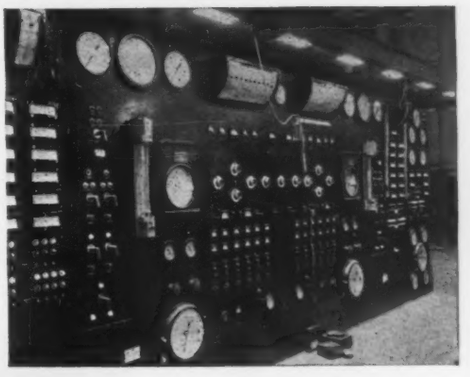
GENERATING and SUB-STATIONS

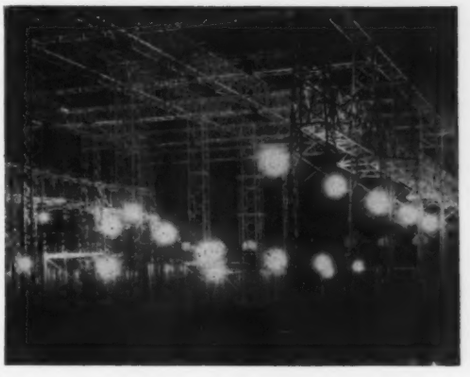
GENERATION

Holophane HIBAY units for generating stations give the "punch" and "concentration" necessary for adequate illumination. They give more light year after year because they have no permanent depreciation.

OPERATION

Accurate control of light with Holophane CONTROLENS IN-BILT lighting for switchboard and control board lighting makes SEEING quicker and easier.





DISTRIBUTION

SEEING is Safety and Efficiency in outdoor sub-station operation. Holophane sub-station units light the operating points and the ground adequately and without glare in the operator's eyes.

Power Plant Engineers will want the new booklet "Lighting Specific for Generating and Sub-Stations." . . . .

Write for your FREE copy.

Holophane Trade Mark

HOLOPHANE COMPANY, Inc.

342 MADISON AVENUE NEW YORK CITY

Every phase of electrical maintenance and repair work covered in this NEW Library

5 volumes of practical how-to-do-it information

Every man concerned with the care and repair of electrical machinery should have these practical books, with their helpful tables, diagrams, data, methods and kinks. Every one of the five volumes is jammed to the covers with sound, how-to-do-it information—the kind you have to have when anything goes wrong. Liberal use has been made of practical data and practice in repair shops so as to combine the good features of a library of methods with handbook information covering these methods.

Electrical Maintenance and Repair Library

2042 pages, 1721 illustrations and diagrams

These books show you how to

—install all types of motor and generator units;
—locate breaks in armature windings and do a workmanlike job of rewinding;
—know just what is wrong with an electrical machine and take charge of installation and maintenance work;
—make accurate tests of switchboards and apparatus and correctly balance the power with the load;
—handle every sort of wiring job;
—show competence, whether it be in the use of a Stillson wrench or a Wheatstone bridge.

New trouble-shooting book

Now, in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a new book full of helpful maintenance information, special trouble-shooting charts, explanation of symptoms and causes of machinery troubles, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

10 days' examination
Easy monthly payments

We want you to examine this Library for 10 days. If you don't want them at the end of that time, there's no obligation to keep them. On the other hand if you decide you want the help these books can give, start the small monthly payments then, and in a short time the books are yours, right while you have been using them. Send the coupon today.

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.,
330 W. 42nd St., New York, N. Y.

Send me Electrical Maintenance and Repair Library, 5 volumes, for 10 days' free examination. If I find the books satisfactory, I will send you $1.00 in 10 days, and $2.00 a month until $15.00 has been paid. Otherwise I will return the books postpaid.

Signature .....
Address .....
City and State .....
Firm or Employer .....
Position ..... F 3-26-38
(Books sent on approval in U. S. and Canada only.)

Field Reports on Business

The most encouraging sign in the electrical manufacturing industry is the working off of inventories and depletion of warehouse stocks. This means new production in the near future. Appliance sales drives continue to feature the work of the utilities with heavy construction delayed.

NEW YORK

Despite the national as well as international disturbances, which have caused a severe case of jitters among some industrial leaders, business is holding up exceptionally well. In some lines the volume of business is close to a year ago, while in others the decline has not been as sharp as previously expected.

Manufacturers report that while their business as a whole is under a year ago, there are specific lines which show makings of expansion. This phase of activity has lent encouragement that business may pull itself out of the present recession, once given an opportunity free from political punitive tax and other measures.

Retail outlets report a lot of window shoppers, with sales in selective bargain classes. With the coming of spring and the chance of a greater spurt in building operations electrical appliance manufacturers expect an expanding volume of trade. Electric water heaters and ranges are being pushed with extra vigor. Refrigerators are soon to come in for special attention. In the lighting field great strides have been made during recent weeks.

A check-up on manufacturers' stocks indicates that these are being moved into retail channels in preference to making shipments from production lines. Indications are, based on present shipments, that should sales hold to present levels production schedules will have to be stepped up. An increase in retail sales will accentuate the situation.

While business in this section is showing little change from recent weeks, there has been an increase in the number of inquiries, which observers hold, is promising.

NEW ENGLAND

More inquiries for electrical equipment and steadiness in buying in small lots in this district seem to indicate that an upward trend in activity may be ushered in with the beginning of the second quarter. Small motor sales are confined to single orders; some large motors for both water and sewage pumping are being considered in plans for the extensions of water systems which will be voted on soon in municipal meetings.

Encouragement is given to the local industrial situation through the announcement that the B. F. Sturtevant Company, Hyde Park, Mass., has received orders for 22 units to air-condition Canadian Pacific cars. Lynn Gas & Electric Company has purchased a Merrick weightometer, capacity 150 tons per hour, to replace a unit recently destroyed by fire. An order for 21 steam turbine and transmission units for Brazilian destroyers, in addition to recent large orders for U. S. Naval and merchant marine use, has been received by the B. F. Sturtevant Company.

Merchandising is progressing slowly in the Boston area. In Vermont range sales to date are ahead of last year and refrigerator sales are gaining.

New factory additions are announced by the Norton Company, Worcester, at a cost of $263,000, and by the Westinghouse Electric & Manufacturing Company at Springfield, Mass., cost $1,250,000.

PACIFIC COAST

Incessant rain, coupled with San Joaquin Valley and southern California floods, has retarded building construction nearly two months beyond normal progress and nearly paralyzed retail purchasing in some areas. However, encouragement is expressed over amount of work awaiting favorable weather conditions, the value of building permits in San Francisco, for example, having nearly doubled the February total during the first three weeks of March. Prices are steady, barring an occasional national drop and despite the prevalent practice of buying construction material in the smallest permissible quantities.

Specific sizable orders include $29,000 for an electric window guard system at Alcatraz prison; 500 miles of iron wire and accessories purchased through San Francisco for telephone lines in various national parks, mostly in Virginia and Kentucky; a $6,543 award for underground electric service at Reeves Field, near Los Angeles, and awards for the Kendrick, Wyo., distribution system covering $348,945 to Anaconda for copper wire and $87,570 to Aluminum Co.; a $37,580 award covering two motor-driven pumps for the Glendive project in Montana, and $30,000 of rubber-covered wire, largely 30 per cent para, for the San Francisco exposition.

Heavy machinery sales are good, the outstanding item covering a 75,000-kva. turbogenerator for a northern California lumber company, the value being $180,000 with accessories.

CHICAGO

Mild improvement in business was in evidence last week. The gains made were slight and not impressive enough in themselves to warrant optimistic interpretation. One thing that offers some encouragement, however, is that excessive year-end inventories have been worked out to the point where they are practically normal. Orders for raw material and replacement parts are beginning to improve.

Steel production in this district climbed a few notches and automobile output is scheduled for an increase within the next two weeks. Utilities and the heavy industries are still withholding their construction programs until the muddled condition of business becomes more clarified. There is a sizable volume of rehabilitation work in progress on smaller plants and stores, which is producing a fair amount of electrical business. Wiring contracts on two public buildings have been awarded and new fixtures are being installed in many stores. About 50 per cent of these jobs also include air-conditioning installations. Appliance sales campaigns are being especially emphasized by dealers and utilities and from all indications are bringing favorable results.

Retail trade more than held its own last week and is apparently on the upgrade.

Water Heaters Boost Average Domestic Usage

[*Continued from page 42*]

plumbing, we are able with these rates to supply hot water to the family using on an average of from 30 to 35 gal. of hot water per day for $3 a month, which is approximately one-half the operating cost in instances of inefficient installations and under our rate of 1½ cents per kilowatt-hour.

Instead of selling only the 50-gal. heater, we now have four sizes, 30, 52, 66 and 86 gal. In larger homes, or under unusual conditions, we carefully survey the house, recommend changes in pipelines, using small diameters where possible to reduce losses, locate heaters nearest the most used faucet, discourage plumbing the storage electric heater direct to the furnace coil (where coil is used we recommend a tempering tank) and, if necessary, sell two or more heaters to be located for the most efficient service. Our objective is to have the storage capacity large enough to take care of the maximum day without having the upper or higher wattage unit on over a long period.

Last year we sold 590 storage type heaters and the year before 400. The total number installed now represents approximately 3.5 per cent of our domestic customers. Beginning with 1930, our annual energy consumption per domestic customer has been 427, 476, 485, 481, 507, 538, 597 and 650 kw.-hr. If we judge the increase per customer in 1937 over 1936 by the number sold during the latter year, compared with the former, the load-building value of the storage type heater seems clear.

Our present types of storage water heater have proved very satisfactory and economical. Heavy insulation, hand-packed around the heavy monel metal tank; two units immersed in water, so that no heat is lost in transfer; thermostat welded to the side of the tank for quick and positive action, and a cold water deflector to prevent mixing of incoming cold water with the hot water in the tank are notable features. In a field test we have drawn 40 gal. of water from a 50-gal. heater without 1 degree drop in temperature. The heater has a trap to prevent hot water circulation when no draft is being made and a 20-year guarantee against corrosion or failure.

Specify the Burndy

STUD MOLE

A MULTIPLE TERMINAL BUSHING

on network protectors

WHAT IT IS:

A combined insulated multiple terminal and bushing for use in underground distribution.

WHAT IT DOES:

Replaces porcelain bushings; uses only one gasket to seal out moisture and gas; provides multiple outlets in small space; used with all types of cables—leaded or non-leaded. Details on request.

PAT. NO. 2,087,384 OTHERS PENDING

BURNDY

ENGINEERING CO., INC. 459 E. 133d ST., NEW YORK

STANDARDIZE ON

SHERMAN

SPLICING SLEEVES

Three types cover practically every need. Sherman Splicing Sleeves offer true economy because of the uniform high quality of their manufacture —a characteristic of all Sherman products.

TINNED SPLICING SLEEVE
(Split-Connector)

Ample tensile strength and when properly soldered wire will break before loosening in sleeve. Tests show no tendency to overheat. Use on either round or sector shaped cable. All surfaces smoothly tinned. Send for bulletin No. 20.

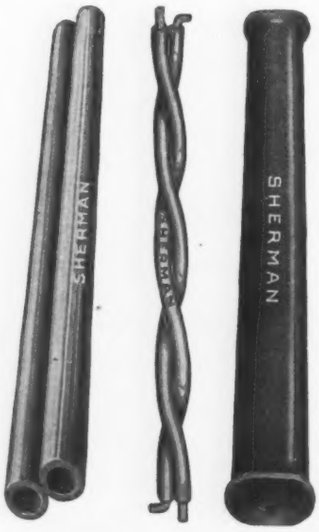


FIGURE EIGHT DOUBLE TUBE

Made from extra quality electrolytic copper of high conductivity. Seamless and free from burrs. Correctly tempered. Send for Bulletin No. 20.

OVAL SINGLE TUBE

Free from burrs and of proper temper. Carefully grooved throughout their length to prevent buckling outward when twisted. Manufactured in accordance with tentative specifications suggested by N. E. L. A. Committee. Send for Bulletin No. 20.

H. B. SHERMAN MFG. CO.
Battle Creek **Michigan**

Rectifiers Fit the Needs of Coal Mining Operations

[*Continued from page 36*]

four conduits complete with wiring, making a total of fourteen parts.

After the foundation at the new location has been completed the actual dismantling, moving and erection will require no more than two days. Obviously the cost of the foundation will represent most of the cost of relocation. This total cost should be less than 2 per cent of the cost of the station. The trolley of the system will be at negative potential so that the rectifier tank can be grounded.

Outdoor location has advantages

The outdoor location of auxiliary equipment has many advantages. Outside location of the high-voltage circuit breaker allows the equipment inside the substation to be operated at about d.c. output voltage, in this case 550 volts; removal of high potentials from the inside of the substation should contribute considerably to safety; outside heat exchanger installation allows for considerable reduction in the size and cost of the substation building; the necessity of complicated air ducts and passageways through the wall of the building is eliminated and a greater quantity of air may be moved through the heat exchanger for the simple reason that there is no resistance to air-flow other than that present in the unit itself. A water-to-air heat exchanger is used because a water supply frequently is not available at the mine substation location. The use of "Prestone" in the rectifier makes it definitely an all-weather unit, providing excellent protection against cold weather. Further, Prestone contains a rust inhibitor which successfully prevents corrosion of the rectifier water jacket and piping, eliminating the necessity of dismantling the rectifier for the purpose of cleaning the water jacket.

The efficiency of the ignition type rectifier is somewhat higher than that of the single-tank rectifier, which, in turn, is definitely higher than either the rotary converter or synchronous motor-generator when operated at 550 volts. The high light load efficiency of rectifiers is particularly desirable in mine service because of the low load factor usually found at mines. The best load factor does not usually reach 60 per cent and a load factor of 40 per cent is considered above standard.

Pay off in about four years in savings

At one large Pittsburgh Coal mine a 600-kw. rectifier is saving, due to its increased efficiency, 26.5 per cent of the rectifier cost each year when compared to a synchronous motor-generator. Savings in the 250-volt field are not quite so attractive, but are nevertheless very much worth having.

The overload characteristic of rectifiers makes them quite suitable as mine conversion units, since high instantaneous loads are the rule rather than the exception. Most conversion apparatus for mine service is selected on the basis of its instantaneous capacity, so that, generally, the rectifier may be smaller in capacity than rotating equipment to handle the same job.

The ease with which voltage regulation may be obtained in the case of the ignition type rectifier is an advantage, regulation being achieved simply by shifting the phase of the voltage to the grid of the ignition tubes. Parallel operation presents no problem in that the face substation is usually a mile or more from the haulage substation. Maintenance and reliability of the ignition type rectifier, as well as the conventional type rectifier, has proved superior to that of rotating apparatus.

The first ignition type rectifier to be applied for industrial power conversion was made in February, 1937. Three portable stations of the same 330-kw. size have just been installed by the Weirton Coal Company, near Uniontown, Pa. These stations are completely portable in that all equipment is mounted on three trucks.

Research on the ignition type of rectifier is constantly going forward in both the Westinghouse and General Electric laboratories. At the present time 250-volt, sealed-off, six-phase rectifiers rated at 100 kw. are available. These steel tubes are water-cooled, are 6 in. high and 7 in. in diameter. Steel air-cooled sealed-off tubes are in experimental service and considerable possibilities are indicated. New methods of ignition seem to be just around the corner.

Sales Opportunities

MARSHALLTOWN, IOWA—Iowa Electric Light & Power Company, Cedar Rapids, Iowa, plans extensions in transmission lines in parts of Marshall County. Application has been made for permission.

WALLA WALLA, WASH.—Pacific Power & Light Company, Portland, Ore., is considering installation of new street-lighting system in downtown district at Walla Walla.

CHILLICOTHE, MO.—Board of Public Works, John R. Taylor, chairman, will take bids soon for boiler unit and accessory equipment, switchboard, instruments and other miscellaneous equipment for municipal electric power station, where expansion will be carried out. Entire project will cost about $300,000. Henrici-Lowry Engineering Company, West Tenth Street Building, Kansas City, Mo., is consulting engineer.

BROOKLYN, N. Y.—Signal Corps Procurement District, Army Base, Fifty-eighth Street and First Avenue, receives bids until April 4 for 1,016,000 feet of wire, 91,800 feet of cable and 28 reels (Circular 154); also, until April 1 for 7000 feet of cable and seven reels (Circular 153).

GLOUCESTER, N. J.—Sherwin-Williams Company, 101 Prospect Avenue, N. W., Cleveland, Ohio, manufacturer of paints, oils, varnishes, etc., plans installation of motors and controls, regulators, conveyors, electric hoists and other equipment in new paint pigment plant at Gloucester, where company has acquired former shipyard of Pusey & Jones Company, and will use as site for several one and multi-story units. Work is scheduled to begin soon. Cost about $500,000.

JACKSON, MISS.—Will ask bids soon for new municipal electrical distributing system, including main transmission line for connection with high-tension system of TVA, from which service will be secured, and three power sub-stations, with transformers, switchgear and auxiliary equipment. This will comprise first section of system and is estimated to cost about $135,000. Entire project will cost about $660,000. Freeland, Roberts & Company, Nashville, Tenn., are consulting engineers.

KNOXVILLE, TENN.—Director of Purchases, Tennessee Valley Authority, Knoxville, receives bids until March 31 for four 102-inch ring seal gates for regulating conduits at Hiwassee Dam.

NEW LONDON, N. C.—Duke Power Company, Charlotte, N. C., has concluded arrangements for acquisition of transmission and distributing lines of Central Electric & Telephone Company, from New London to Misenheimer, Stanly County, and will take over property at once. Improvements will be made, including line extensions for connection with company system.

FLANDREAU, S. D.—Has plans under way for expansion and improvements in electric power plant of Union Public Service Company, recently acquired for municipal property, including installation of two new engine-generator units and auxiliary equipment. Proposed to arrange financing through Federal aid. Buell & Winter Engineering Company, Insurance Exchange Building, Sioux City, Iowa, is consulting engineer.

VANCEBURG, KY.—Plans early call for bids for new municipal electric power plant, for which bonds in amount of $148,000 have been authorized. H. N. Herrmann, 3946 Ledgewood Drive, Cincinnati, Ohio, is consulting engineer.

MUSKEGON, MICH. — Norge Division, Borg-Warner Corporation, 670 East Woodbridge Street, Detroit, Mich., plans installation of motors and controls, conveyors, electric hoists and other equipment in new two-story addition to electric refrigerator and range plant at Muskegon Heights, approximating 150,000 square feet of floor space, for which bids are scheduled to be asked soon on general contract. Cost about $400,000.

BINGHAMTON, N. Y.—New York State Gas & Electric Corporation plans extensions and improvements in street-lighting system in downtown area and residential districts, including installation of improved equipment. Work will begin soon.

YUMA, ARIZ.—Nevada-California Electric Corporation, Riverside, Calif., plans overhead transmission line across Colorado River at Yuma, comprising a three-wire circuit to operate at 2300 volts. Line will be carried 32 feet above high-water stage of river. Application has been made for Federal permission.

KNOXVILLE, TENN.—Is completing plans for portion of new municipal electric power system, using TVA power, consisting of transmission lines for power service for industrial consumers, to be known as District No. 1 of system. Cost estimated at $450,000, including poles, pole hardware and fittings, wire and cable and other line materials. Bids will be asked soon. Entire project will cost $2,600,000. Burns & McDonnell Engineering Company, 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

PITTSBURGH, PA.—West Penn Power Company has plans for extensions in primary and secondary lines in six counties for additions to rural electric system. A total of about 26 new lines are included in project, which will be carried out this spring. Permission has been secured.

VICKSBURG, MISS.—Marquette Cement Manufacturing Company, 140 South Dearborn Street, Chicago, Ill., plans installation of motors and controls, power drives, conveyors, loaders and other equipment in new bulk cement terminal plant at Vicksburg, where site has been selected. Cost close to $250,000. Company engineering department will be in charge.

MINERAL WELLS, TEX.—Brazos River Conservation and Reclamation District, Kyle Hotel Building, Temple, Tex., has plans maturing for proposed hydroelectric generating plant at new Possum Kingdom dam on Brazos River, near Mineral Wells, and project is under consideration by Federal Power Commission to determine features of station and proposed power distribution in that area. Bids have been asked for dam construction and work will be placed under way soon. A Federal appropriation of $4,500,000 has been made. Ambursen Engineering Corporation, 295 Madison Avenue, New York, N. Y., is consulting engineer for dam; John A. Norris is chief engineer and general manager.

MARION, ILL.—Central Illinois Public Service Company, Springfield, Ill., plans new transmission line from Marion to Goreville, Ill., where power substation and distributing system will be installed for local service.

ROME-CABLE
ROME, N.Y.

To buyers of rods, wires, and cables, we offer a line of products which meet exacting specifications

We will be pleased to quote on your requirements for

HOT ROLLED COPPER RODS
BARE & TINNED COPPER WIRE
(In rounds, flats & squares)
BARE & TINNED STRAND
U. R. C. WEATHER PROOF WIRE
MAGNET WIRE
FLEXIBLE CORDS
RUBBER COVERED WIRES & CABLES
LEAD COVERED CABLES

ROME CABLE
CORPORATION
Mills and executive offices
330-400 Ridge Street
ROME, N. Y.

SALES OFFICES:
New York Chicago
Cleveland Pittsburgh Boston
Richmond Philadelphia Dallas
Los Angeles

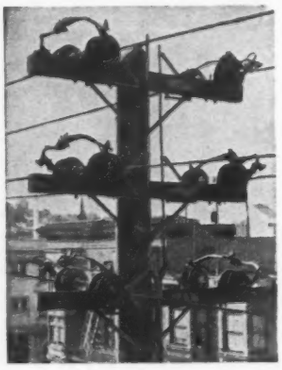
25 YEARS
OF
CONSTRUCTION
EXPERIENCE

TRANSMISSION LINES
SUBSTATIONS
RURAL LINES
OVERHEAD-UNDERGROUND

*Submit your next line erection project to MILLER-BAXTER for an estimate. This organization is equipped to handle all line construction needs quickly and at savings in cost. Our experts work according to most modern practices and have successfully served many leading utilities. Our crews and equipment are available to begin now.

The MILLER-BAXTER CO., Inc.
445 N. PENNSYLVANIA AVE.
INDIANAPOLIS, IND.

K-P-F
Pole Top Switches



Due to
Inherent Flexibility they
allow many types of
mounting Economically.

For Catalogue
Mail Coupon
To
K-P-F ELECTRIC CO.
855 Howard St., San Francisco
Name
Co.
City
St.

Recent Rate Changes

DUKE POWER COMPANY has announced a new rate schedule saving consumers in the Carolinas more than a $1,000,000 annually. North Carolina consumers will receive an annual reduction of $838,000 under the 1937 charges, and South Carolina consumers $303,000 annually. The new residential rate is 80 cents for the first 10 kw.-hr. a month; 4 cents per kilowatt-hour for the next 40 kw.-hr.; 2.5 cents per kilowatt-hour for between 50 and 130 kw.-hr. and 2 cents per kilowatt-hour for all over 130. The old rate was 80 cents for the first 10, 5 cents per kilowatt-hour for the next 20, 3.5 cents per kilowatt-hour for the second 20 and 2.5 for more than 50. The new commercial rate is 80 cents for the first 10 kw.-hr., 4 cents per kilowatt-hour for the next 90, 3.5 cents per kilowatt-hour for the next 300 kw.-hr., 2.5 cents for the next 1,600 kw.-hr., 1.7 cents for the next 8,000 and 1.25 cents per kilowatt-hour for the next 10,000 kw.-hr. The old rate was 80 cents for the first 10 kw.-hr., 4.5 cents per kilowatt-hour for the next 90 kw.-hr., 4 cents for the next 400, 3 cents for the next 500 kw.-hr., 2.5 cents for the next 1,000 kw.-hr. and 1.9 cents per kilowatt-hour for excess of 1,000 kw.-hr.

WISCONSIN GAS & ELECTRIC COMPANY and WISCONSIN MICHIGAN POWER COMPANY have been ordered by the state Public Service Commission to reduce their rates $45,710 annually. Customers of Wisconsin Gas & Electric will save $28,000 annually and those of Wisconsin Michigan $16,910.

MADISON GAS & ELECTRIC COMPANY has announced a $37,000 annual reduction, effective on May bills, for its customers. The reductions is made up of $3,000 in charges to the city for street lighting; $6,000 in industrial power uses; $16,000 for small business customers and $12,000 for large business customers.

CAROLINA POWER & LIGHT COMPANY has announced a reduction in rates for municipalities, which buy power at wholesale for resale. Stanley Winborne, of the North Carolina Public Utilities Commission, said the rates would save municipalities at least $36,000 a year. If municipalities enter into a ten-year contract, they will get a further reduction of 3 per cent discount on each monthly bill. The average rate effective immediately, he said, will be cut from 1.47 cents to 1.425 cents a kilowatt-hour. The rates also will apply to rural electrification co-operatives the commissioner said.

MISSOURI UTILITIES COMPANY has filed with the state Public Service Commission a new electric rate schedule, embodying a 19.3 per cent reduction, applying to 27 towns and estimated to save consumers $21,600 annually.

ILLINOIS COMMERCE COMMISSION has announced that reductions in electric rates in the month of February by companies supplying electric light and power service in the state amounted to $36,577.

SOUTHWESTERN GAS & ELECTRIC COMPANY'S new rate for power, embodying an annual reduction of approximately $8,800 for operators of about two dozen coal mines in the Huntington district of Sebastian County, Ark., has been approved by the Arkansas Utility Commission. The schedule will be effective on all bills issued since December 24, 1937, and ends a long drawn-out controversy between the mine owners and the utility company.

HERKIMER, N. Y., has filed revised electric rates with the New York Public Service Commission which are estimated to reduce charges to customers of the municipal plant by about $12,000 annually. The bulk of the reduction will go to commercial customers outside the village.

•

Municipal Plants

RUSSELLVILLE, ALA.—Alabama Public Works Board has an application from this town for authority to sell approximately $124,000 in bonds with which to construct a municipal power system for the use of TVA energy. Alabama Power Company now serves the town.

LA JUNTA, COLO.—In spite of the fact that the Southern Colorado Power Company has announced that it would construct a generating plant in this city and not depend on transmission from its Pueblo plant, city officials will ask voters in an April election to approve the issuance of $497,000 of bonds to finance the erection of a municipal electric plant.

HUNTINGTON, IND.—New court action to prevent the city from entering the utility business has been taken with the filing of a petition in circuit court asking an injunction and damages against the city in connection with a recent contract with Burns & McDonnell to survey possibilities of the city expanding its electric business. Mayor C. W. H. Bangs, members of the board of works, the city treasurer and the engineering firm were named defendants. Representatives of the city immediately asked a change of venue.

DURANT, IOWA—At a recent election voters decisively defeated the proposal that the city construct a municipal light and power plant and distribution system to cost approximately $100,000.

BOSSIER CITY, LA.—City council has set April 5 as the date for election on a proposed bond issue of $350,000 for construction of a municipal light plant and a natural gas distributor.

TRENTON, MO.—U. S. Circuit Court of Appeals has affirmed the ruling of Federal Judge Otis at Kansas City denying the Missouri Public Service Corporation's suit to prevent the city from constructing and operating a municipally-owned electric power plant. The plant, since the ruling of Judge Otis April 3, 1937, has been completed and placed in operation. The utility charged the contract for the construction was unlawful in that bids were advertised in a paper having less than 50,000 circulation. The opinion of the Court of Appeals stated: "A decree which would leave the city of Trenton with a power plant on its hands, which it could never operate merely because it published notices in the wrong newspaper could not be justified." The decision brushed aside other charges of the utility company with the statement the complaint involved little more than minor irregularities which prejudiced no one.

VANDALIA, MO.—Residents voted recently to issue $145,000 in bonds with which to erect a municipal power plant and distribution system. Missouri Power & Light Company's electric franchise expired last April.

COLUMBUS, OHIO—Immediately following the dissolution of a three-year-old federal court injunction on the basis of the recent U. S. Supreme Court decision holding federal grants to cities for municipal power plants are legal, Charles Kurtz, a director of the Columbus & Southern Ohio Electric Company filed suit as a

taxpayer in Franklin County common pleas court, challenging the validity of a bond issue to finance a $1,030,000 expansion program for the Columbus municipal light plant. Judge Mell G. Underwood had set aside the injunction issued in 1935 restraining the city from building the light plant extension. Mr. Kurtz filed the suit after City Attorney John L. Davies notified him that the city attorney's office would not bring such a suit. In 19 grounds set forth in his petition, Mr. Kurtz contended that the proposed action of the city is illegal and unconstitutional.

HEMPSTEAD, TEX.—City council has voted to call an election for some time in April to vote on the proposal to issue $150,000 revenue bonds for the construction of a municipal electric light and power plant and the purchase of the water supply system.

BUENA VISTA, VA.—At a recent meeting of city council a committee was named to investigate the advisability of a municipally-owned electric light plant.

NORTON, VA.—A bond issue for $150,000 to finance a municipally owned power plant and distribution system was proposed to Town Council in a communication signed by R. H. Bolling, chairman of the Norton Taxpayers League.

Political Boards Not Constructive

[*Continued from page 50*]

tion directorates of the ordinary type is not a new thing. Investment bankers handling club bond issues have known about it for years. They usually try to have provisions written in the mortgage to protect their investors against the whims and eccentricities of club board members.

But a club board is a sane and sensible thing when compared to a politically appointed board. There may be a crabbed member who doesn't like the club manager's choice of waiters, but at least there is no board member conducting a political campaign out the window, thinking not of whether his proposals would benefit the club, but of how the boys in the locker room will like it.

There is seldom such an element as patronage, and never a crusading senator backing the trouble-making member.

Conducting an enterprise such as TVA, or the late and unlamented U. S. Shipping Board, or the U. S. Steel Corporation, is not as dramatic as directing an army on the field of battle. But there are certain similarities. A debating society should not attempt to run any one of them. Particularly a politically appointed and political minded debating society.

Tee Connectors Can Now be
CARRIED IN STOCK

Only 1 Size to take the place of 15

Branch or Tap takes a wide range of either solid or stranded, flexible or hemp core wire and cable.

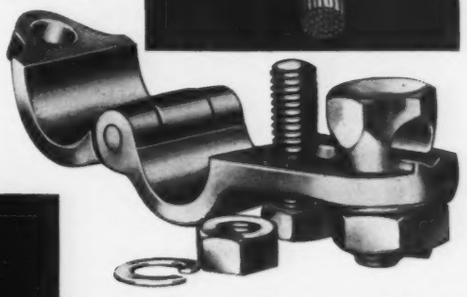
For instance, one size Hinged E-Z Tee connector will take any wire or cable on the tap from No. 6 to 4/0. The next size takes from 1/0 to 500,000.

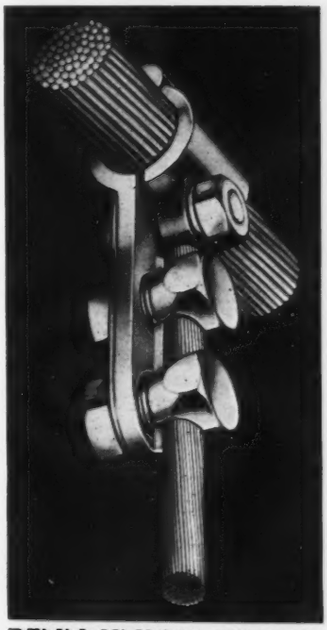
The Main or Run is made for one specific size of conductor.

User can carry for emergencies; a few will meet practically all needs.

Jobber can keep stocked for quick delivery, with only a small investment. New convenience and Economy, in the new—

PENN-UNION Hinged E-Z Tee





One-piece design — just bolt the hinge over the main. No loose parts but the bolt, nut and lockwasher.

No loose parts on the tap: Once the Hinged E-Z Tee is installed on the main, tap connections can be made at any time in a few seconds.

Quickest connection — and **Permanent.** Not loosened by vibration, as the nuts are self-locking. Large holding surfaces, with ample safety factor.

Write for descriptive sheet.

Sold by Leading Jobbers

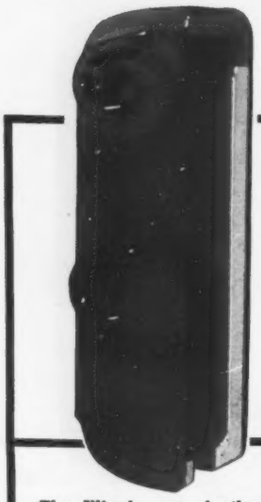
PENN-UNION ELECTRIC CORPORATION, Erie, Pa.

You'll find fittings for every type of connection, in the *complete* line—

PENN-UNION
Conductor Fittings

ILLINOIS

SPECIAL PORCELAINS *are* ACCURATE *and* DEPENDABLE



The Illinois organization has produced special porcelain insulators for electrical equipment for almost a quarter of a century. The constant growth of this service to electrical equipment manufacturers has undoubtedly been due to the close attention given this type of work in our plant. The most modern facilities are available for producing special porcelains of unvarying high quality.

Precision control of each step in the process of manufacture assures absolute accuracy and trouble-free assembly. Rigid tests and inspection practices assure maximum dependability and long life.

Whether you are modernizing old equipment or designing new units investigate Illinois service. Our engineers will gladly make recommendations or cooperate in any way.

We make porcelain products in both wet and dry process as required. Large stocks of insulators are carried at all times and prompt shipments can be made.

Send for samples and catalog

ILLINOIS ELECTRIC PORCELAIN COMPANY

MACOMB . . . . . ILL.

Repeater Fuse Spill Gaps Reduce Lightning Outages

[*Continued from page 38*]

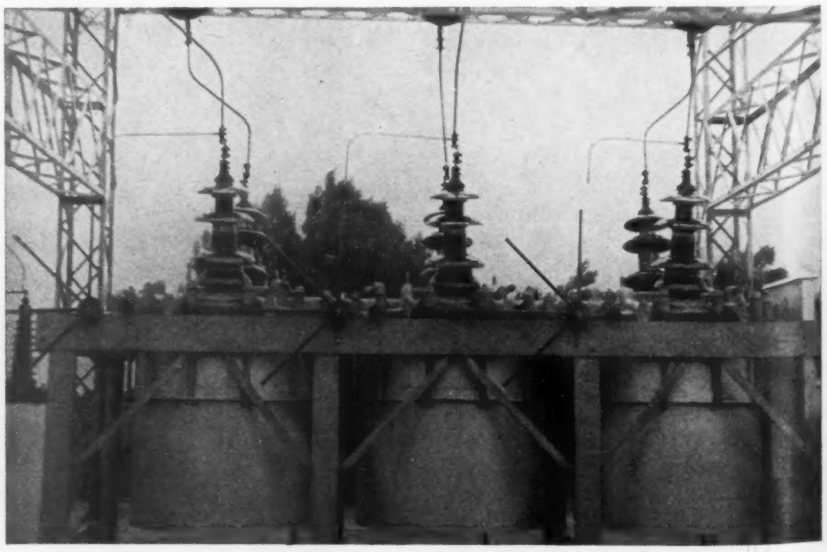
will flash in about six microseconds with 125-kv. surge crest and with 200-kv. surge crest will flash in about one microsecond. These values are well under the breakdown level of most any kind of 69-kv. insulation. The shorter gaps for the lower voltages will of course operate with much lower surge crest and less time lag.

The clearing time for the expulsion fuse is usually around one-half cycle, about 8,000 microseconds. Thus there is plenty of time for several multiple strokes spaced several hundred microseconds apart to be dissipated before the arc is extinguished.

At no point where fused gaps have been installed has there been a transformer failure. Some of the gaps were installed as early as 1931. It was the excellent operating record of the single-shot fused gaps that led us to look around for a repeater fused gap, since with the single fuse, should there be more than one lightning surge in the same station before the fuse could be replaced, the equipment would be without protection. At that time repeater fuses had not been developed for high voltage, and even though they had, the conventional type would have been too expensive for such application. Several types of repeater fuses were designed and tested, all of which had some mechanical weakness, especially those that depended upon some sort of spring to replace the blown fuses. Finally, the present design using four fuses was worked out and a local manufacturer undertook to produce the devices at a low cost. The Wolff Manufacturing Company of San Antonio is now manufacturing and distributing these devices, known as "Expulsion Type Surge Arresters."

During the early part of 1936, 103 repeater fused gaps were installed and their operation carefully watched. After each lightning storm attendants visited the installations, re-fused the devices that had operated and kept records of the operations. A summary of these records appears in the accompanying tabulation. It was at once apparent that substation transformers were being subjected to a great many more lightning surges than we suspected and that the repeater fused gaps were an excellent means of providing low cost protection. Therefore, during the latter part of 1936, 71 more units were installed, and before the 1938 lightning season sets in 200 additional units will be installed. When these installations are complete all substation transformers will be protected by repeater fused gaps on the high voltage and a number of units will also be installed on the low voltage at points where lightning is particularly severe.

Of the seventeen cases shown in the tabulation, of all four fuses operating between inspections, fourteen occurred at end of the line stations. Also the 936 average operations per unit per year for the system was 3.4, while average operations per



Gaps installed on line side of 69-kv. breaker

unit per year for end of the line stations was 6.5. Due to more frequent operation of the devices located at end of the line stations, we plan to change some of these installations to eight-fuse repeaters.

Thirty of the present installations are at attended stations where operators have on several occasions reported the gaps spilled over without system follow-up current, indicating that the lightning surge was dissipated during the instant of very low or zero system voltage.

Nine of the gaps are installed on the line side bushing of oil circuit breakers at a 69-kv. station where lightning is particularly severe. This station also has fused gaps at the transformer bushings. The station is protected by three ground wires over it and extending one mile out on each of the three 69-kv. lines. There have been 26 gap operations at this station, two on the transformer gaps when the line gaps did not operate and 24 operations of the line gaps. On no occasion has more than one gap operated on the same phase nor have the transformer and line gaps ever operated simultaneously. Of the 24 line gap operations, twelve were on one line, five on another and seven on the third.

Although the repeater gaps have only been in operation for two years, single-shot fused gaps have been used for a number of years and it is significant that at no point where fused gaps were installed has there been a transformer failure due to lightning. At one 38-kv. station three transformers failed in 1930 and one more in 1931. Fused gaps were installed in 1932 and there have been no more failures. At a 69-kv. station two transformers failed in 1931 and two more in 1932. Fused gaps were installed after the 1932 failure and there have been no more failures. At another 69-kv. station two transformers failed in 1932, two in 1935 and two more in 1936. After the 1936 failures fused gaps were installed and there have been no more.

•

Opens New Chicago Office

Fairbanks, Morse & Company has formally opened its new Michigan Avenue office building in Chicago. Col. Robert H. Morse, president, said the fact that the company has rebuilt five floors of 15,000 sq.ft. each is evidence of business confidence.

ILSCO

A SPRING TONIC for wiring profits . . . Ilsco lugs and connectors will pep up every job . . . save you time and money for increased profits

SIMPLICITY of design and quality construction characterize the ILSCO line of lugs and connectors, providing a convenient, dependable attachment for every purpose. Only the highest-grade copper is used, for maximum strength and conductivity; and stamped in clear view are wire-size and Underwriters'-Approval markings, as well as ampere rating on the Soldering Lugs, to assist you in selecting the right lug for every job.

SEND FOR NEW BULLETIN AND SAMPLE BOARD SHOWING COMPLETE LINE

ILSCO COPPER TUBE & PRODUCTS, INC.
5629 Madison Road, Cincinnati, Ohio

SOLDERLESS ING LUGS and CONNECTORS Simplicity Itself

Now Available

on small monthly payments

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS

Editor-in-Chief, Frank F. Fowle, Consulting Engineer — Assisted by 91 specialists

Sixth Edition — 2816 pages

NOW you can start using the Standard Handbook at once—paying in small monthly installments while you use it. No strings to the offer—no mark-up to pay installment charges—no difference in quality of the book. Just a special offer to urge action.

Tens of thousands of engineers get real benefits from the Standard. You will too. *On hand when you need it,* it will give security in troublesome situations, save dollars, hours and effort by giving the right, dependable answer at the right time. Take this easy step that may mean much to you later. Mail the coupon now.

28 helpful sections

Units and Conversion Factors
Electric and Magnetic Circuits
Measurements and Measuring Apparatus
Properties of Materials
Magnets, Induction Coils, Condensers and Resistors
Transformers, Regulators and Reactors
Alternating-current Generators and Motors
Direct-current Generators and Motors
Converters and Rectifiers
Steam, Gas and Oil Prime Movers
Hydraulic Prime Movers
Power-plant Electrical Equipment
Power Plant Economics
Power Transmission
Power Distribution
Wiring of Buildings and Industrial Plants
Illumination
Industrial Motor Applications
Electric Heating Applications
Electric Railways
Electric Trucks and Buses
Marine Power Applications
Electrochemistry and Electrometallurgy
Batteries
Wire Telephony and Telegraphy
Radio and Carrier Communication
Electron Tubes and Electric Wave Filters
Miscellaneous Electrical Applications

McGRAW-HILL ON-APPROVAL COUPON

McGraw-Hill Book Co., Inc., 330 W. 42d St., New York City

Send Standard Handbook for Electrical Engineers for 10 days' examination on approval. In 10 days I will send $1.00, plus few cents postage, and $2.00 monthly for 3 months, or return the book postpaid. (Postage paid on orders accompanied by remittance of first installment.)

Signed .....

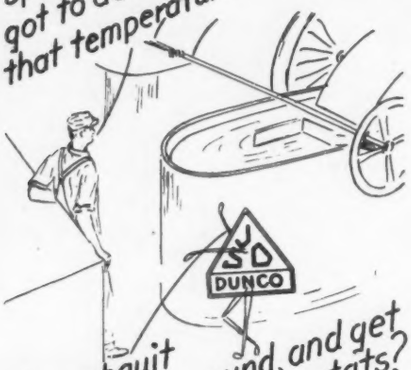
Address .....

City and State .....

Position .....

Company ..... W 3-26-38

Another batch spoiled! We've simply got to do something about that temperature control.



Why not quit fiddling around, and get Dunco Thermostats? Send for their catalog

DUNCO
Means Dependability

STRUTHERS DUNN, Inc.
142 N. Juniper St. Philadelphia, Pa.

Isn't this Simple?

With the VOLTOR attachment Tong Test can also be used to measure voltage

Current measuring becomes a speedy, inexpensive operation with a Tong Test Ammeter. You simply encircle the conductor and take the reading! Just as easy as that! (see above photo). No break in insulation or circuit.

Tong Test measures A. C. or D. C. up to 800 amperes—in motors, transformers, cables, etc. Absolutely safe. Accurate. Low in price. Weighs only 2¾ pounds.

Save time and money. Equip your service department with Tong Tests. Get the complete story of this remarkable instrument by sending for the Tong Test bulletin, today.

Columbia Elec. Mfg. Co.
4529 Hamilton Av., Cleveland, O.

TONG TEST AMMETERS

Manhole Units Evolved to Lower Cost Installed

[*Continued from page 45*]

the main tank before the core and coils are installed. Past experience showed that mechanical trouble or failure of this type of rugged, simple, phase-isolated switch was so rare that it might well be installed in this manner to eliminate separate gaskets for the ground switch compartment. The primary connection is made by a bayonet type terminal which is interchangeable in all units.

Accessories combined with transformer

The transformer cover contains all the accessories for maintaining and operating the transformer. All these accessories can be removed to lift the cover with the unit installed in a manhole, if such an operation becomes necessary to replace a cover gasket or make any other internal repair. The ground switch handle on the main cover protrudes through a packing gland in a small gasketed plate, under which is located the electric interlock coil. Adjacent to the ground switch handle is the ratio adjuster operating handle interlocked with the ground switch, a magnetic type oil level gauge, a dial type thermometer, a filter valve, and a pressure test cock. The oil gauge and thermometer have hinged metal covers to protect them from damage. The bottom drain valve and a bottom sampling cock at the cover level are connected to the bottom of the tank through double extra heavy pipe run in between the radiator tubes. To obtain a bottom oil sample gas pressure is introduced through the pressure test fitting to force the oil up through the bottom oil sampling fitting.

Accessories located on the network protector cover include red and green bullseyes for indicating switch position, fuse observation windows, a Veeder counter observation window, a switch handle for manually operating the protector through electrical controls, a pipe plug under which is located a push rod for mechanically tripping the protector in case the electrical controls are inoperative, a pressure test fitting and a small cover under which is located a jack in the current circuit. Load readings can be obtained by plugging ammeter leads into this jack.

Complete circuit breaker, operating mechanism, relays, and associated parts are mounted on a panel and frame which slides vertically in a set of guide rails welded to the housing. The network protector has been so designed that every protector is interchangeable in every housing. Connection from the circuit breaker to the transformer and the network mains terminals is made through six self-aligning links located just under the network protector cover. The protector may be removed from the housing after unbolting and removing the six disconnect links and four bolts which mechanically anchor the switch unit. The circuit breaker unit is removed from the housing by use of a small folding "A" frame bolted to bosses on the protector housing and containing a ½-ton chain hoist. This frame has vertical guides to match those on the housing and to keep the breaker rigid when it is lifted out of the housing.

Multiple connector combined with bushing

Network terminals are radical in design. Instead of the network leads being brought out through wiping glands or porcelain bushings, these terminals are brought out through the rear of the protector housing in a combination rubberized entrance bushing and multiple connector shown in Fig. 5.

The complete unit and the associated manhole have several advantages over the other designs. Reduction in gasket surfaces reduces the possibility of leaks, and with all the gaskets at the cover level they can easily be replaced if they do leak. The manhole cover being completely removable in sections permits unobstructed operation of all parts or the complete removal of the unit without tearing up street paving. The interchangeable primary bayonet connections and convenient secondary cable mechanical connectors permit quick removal of the unit and replacement with another or permit the unit to be readily lifted out for periodic painting. The fact that no operating parts are more than two feet below the street level insures that these parts of the unit can be kept dry even in locations where the sewer is relatively close to the street level, or in the event that a sewer connection cannot be obtained, the amount of water that has to be pumped out before the unit can be operated is kept to a minimum. The

small size of the manhole permits it to be installed in locations where unobstructed subsurface space is difficult to obtain.

Costs steadily reduced

The complete installed cost, including manhole construction, for network unit E is the lowest of all the designs, while the complete installed cost of unit D is less than 1 per cent greater, C is 3 per cent greater, B is 5 per cent greater and A is 8 per cent greater. The "lift-out" unit (D) is slightly more expensive than the combination unit E because the "lift-out" protector is more expensive than the conventional horizontal roll-out protector. However, where a space occupancy charge is made the "lift-out" unit may become equal to or lower in installed cost than the combination unit because the combination unit occupies a 25 per cent greater manhole volume. With the two units substantially equal in installed cost, the opinion of the operating and maintenance personnel as to the ease of operating the two designs should determine the standard to be adopted.

It is important to note that the net ventilating area must be increased as the volume of the transformer manholes are reduced. Manhole design A, with inside dimensions of 4 ft. 6 in x 8 ft. 3 in x 16 ft. 11 in., ventilated satisfactorily the losses of 7,500 watts with 8 sq.ft. of net ventilating opening, but the 4-ft. x 8-ft. x 6-ft. manhole D requires 12 sq.ft. of net ventilating opening for satisfactory operation of a unit with only 6,000 watts loss. Considerable heat is usually carried away through the manhole walls, and with the wall area reduced by approximately 50 per cent, which is the difference in designs A and D, additional ventilating area must be provided to insure proper ambient temperature for the network unit.

•

Gives Course on "Electron"

Johns Hopkins University's School of Engineering is giving a course of six lectures on the "electron" and its rapidly expanding use in radio transmission and in the applications of electric power. The lectures are by members of the electrical engineering staff and are open to the public. The course opened on March 9 and will continue on every Wednesday evening through April 20.

STEEL STRAND ✣ TELEPHONE WIRE

Crapo GALVANIZED PRODUCTS

SCIENTIFICALLY MADE TO RIGID SPECIFICATIONS

Crapo Galvanized Steel Strand is a highly specialized product scientifically manufactured under direct laboratory supervision. Each grade and size is produced from start to finish to meet the exacting demands of the service for which it is intended. Each wire used in forming a particular size and grade is made from the same special steel, processed in the same way, and galvanized by the *Crapo* Process.

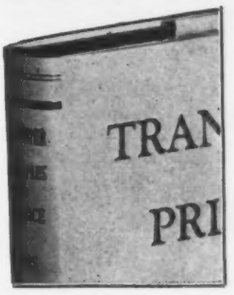
For further information consult the nearest distributor of *Crapo* Galvanized Products, or write direct!

INDIANA STEEL & WIRE CO.
Muncie, - - Indiana

Transformers

— their kinds — fundamentals — uses — operation — maintenance

For the practical man this book deals concisely and plainly with all aspects of transformer construction and use, including underlying principles, applications, connection, testing, care, and economics.



Just published

Transformer Principles and Practice

By J. B. GIBBS

Electrical Engineer, Westinghouse Elec. and Mfg. Co.

210 pages, illustrated, $2.50

FROM this book the reader will get an introduction to the fundamentals of transformer performance and construction, also descriptions of many particular types of transformers, large and small, for various purposes. Usual methods of connecting transformers are described and diagrams given, also special applications of standard transformers, including phase transformation.

Contents: 1. Introduction. 2. Single-phase and Three-phase Transformers. 3. Coils and Cores. 4. Autotransformers. 5. Transformer Cooling. 6. Temperature Indicators. 7. Transformer Polarity. 8. Usual Transformer Connections. 9. Special Applications of Standard Transformers. 10. Parallel Operation of Transformers. 11. Phase Transformation. 12. Phase Transformation by Autotransformers. 13. Ratio Adjustment. 14. Transformer Oil. 15. Maintaining Oil Quality. 16. Mechanical Forces in Transformers. 17. Constant-current-regulating Transformers. 18. Instrument Transformers. 19. Transformer Insulation and Surge Protection. 20. Transformer Testing. 21. Care and Operation of Transformers. 22. New Transformers or Old? 23. Transformer Calculations.

10 DAYS' EXAMINATION ON APPROVAL—SEND THIS COUPON

McGRAW-HILL BOOK CO., INC., 330 W. 42nd St., N. Y. C.

Send me Gibbs' Transformer Principles and Practice for 10 days' examination on approval. In 10 days I will send $2.50, plus few cents postage, or return book postpaid. (We pay postage on orders accompanied by remittance.)

Name .....

Address ..... City and State .....

Position ..... Company F-3-26-38

(Books sent on approval in U. S. and Canada only.)

PROFESSIONAL SERVICES

Consulting Accounting Valuations — Management Appraisals Construction — Designing Testing Financing — Inspections Cost Analysis Investigations

WILLIAM A. BAEHR ORGANIZATION, INC.
ENGINEERS—ACCOUNTANTS—MANAGERS
231 South La Salle St.
CHICAGO

ELECTRICAL TESTING LABORATORIES
Electrical and Mechanical Laboratories
Tests of Electrical Machinery Apparatus and Supplies. Materials of Constructions, Coal, Paper, etc. Inspection of Material and Apparatus at Manufactories.
80th St. and East End Ave., New York

DANIEL W. MEAD
F. W. SCHEIDENHELM
Consulting Engineers
Hydro-Electric Development, Dams, Water Supply, Flood Control. Engineering Problems relating to Water Rights and Water Power Law. Appraisals.
New York City, 50 Church St.

BARKER & WHEELER
Utility and Industrial Valuations, Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal, Factory Production and Cost Control Systems.
11 Park Place, New York City
36 State Street, Albany, N. Y.

FORD, BACON & DAVIS, Inc.
Engineers
DESIGN • CONSTRUCTION
VALUATIONS • REPORTS • INTANGIBLES
Philadelphia New York Chicago
Washington Dallas

Recording & Statistical Corp.
BILL ANALYSIS—CONSUMPTION STUDIES
New Bill Frequency Analyzer Method Investigate
102 Maiden Lane New York

BLACK & VEATCH
Consulting Engineers
Water, Steam and Electric Power Investigations, Design, Supervision of Construction, Valuation, Tests and Laboratory Service.
Mutual Building, Kansas City, Mo.

FRANK F. FOWLE & CO.
Electrical and Mechanical
ENGINEERS
35 East Wacker Drive Chicago, Ill.

SANDERSON & PORTER
ENGINEERS
for the
FINANCING—REORGANIZATION—DESIGN—CONSTRUCTION—of
INDUSTRIAL and PUBLIC UTILITIES
Chicago New York San Francisco

EDWARD J. CHENEY
ENGINEER
PUBLIC UTILITY PROBLEMS
61 Broadway New York

HOOSIER ENGINEERING COMPANY
Erecting Engineers
Transmission Lines, Substations
46 So. 5th St., Columbus, Ohio
431 So. Dearborn St., Chicago, Ill.
136 Liberty St., New York

SARGENT & LUNDY
Incorporated
ENGINEERS
140 South Dearborn St.
Chicago, Ill.

HUGH L. COLEMAN
Specializing in Aerial Transmission Cable
Power Construction
Great Barrington, Mass.

CHARLES F. LACOMBE
WILLIAM S. LEFFLER
Engineers
Public Utility Administrative
Economic and Municipal Problems
Cost Analysis
Inducement Rate Development
Rate Cases—Appraisals
11 West 42nd Street, New York

SPOONER & MERRILL, INC.
Consulting Engineers
Design—Supervision of Construction
Reports—Examinations—Valuations
20 North Wacker Drive, Chicago, Illinois

HUGH L. COOPER & CO.
General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.
101 Park Ave. New York

LUCAS & LUICK
ENGINEERS
Power Plants Transmission Lines
Industrial Plants
Examinations Reports Valuations
Rate Cases
Public Utility Management
231 So. La Salle St., Chicago

STEVENS & WOOD
Incorporated
ENGINEERS AND CONSTRUCTORS
30 Broad Street New York

ROBERT E. FOLEY
Erecting Engineer
Rural Lines—Transmission Lines
Fire Alarms—Telephone Lines
48 Griswold St. Binghamton, N. Y.

Consulting Engineers can give needed advice regarding most any problem for they see each separate department in its relation to the whole plant—and they sell nothing but their broad experienced services.

THE J. G. WHITE ENGINEERING CORPORATION
Engineers—Constructors
Steam and Hydroelectric Power Plants, Transmission Systems, Office and Industrial Building, Air Conditioning, Railroads.
REPORTS and APPRAISALS
80 Broad Street New York

Do people like you instinctively?

Sensible, practical methods for improving your relations with others—securing cooperation of superiors, associates, and subordinates—both in and out of business life. Send $2.50 for a copy on 10 days' approval.

McGraw-Hill Book Company, Inc.
330 West 42nd St., New York, N. Y.

Read GETTING ALONG WITH PEOPLE by MILTON WRIGHT

Design Station Cables on Conservative Basis

[*Continued from page 40*]

the compound between layers is reduced to a minimum. For the higher voltages it is advisable to adopt a butt-wrap construction. The use of this construction insures higher dielectric strength and better electrical properties and should be considered where dry varnished cambric cable must be used at the higher voltages.

Varieties of rubber insulation

Rubber has long been popular as an insulation for station work because of its flexibility, moisture-proof qualities and ease of handling. Rubber cables do not ordinarily require lead sheaths or potheads (indoors) for station applications and they are easier to splice and handle than any other type of cable.

The usual compounds are Code, 30 per cent A.S.T.M. Class AO high-temperature performite rubber, high-temperature moisture-proof performite, corona-resisting rubber and special thin-walled rubber compounds for control cable.

Code wire is used mainly for lighting. It is very little used for power applications inside stations.

Thirty per cent A.S.T.M. Class AO compound is useful for small circuits where loads and temperatures are moderate, but its temperature limitation (60 deg. C.) makes it less suitable than other insulations for larger circuits. Some high-temperature and moisture-proof cable, on the other hand, are rated at 75 deg. C. up to 8,000 volts. Thus, their current ratings are comparable with those of ordinary varnished-cambric cables up to this voltage.

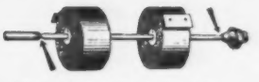
Ordinary corono-resisting rubber is used up to 15 kv., although at the higher voltages and with large conductors varnished cambric or paper are to be preferred. Where the flexibility and moisture-proof character of rubber cable is necessary, however, corona-resisting equipment finds its place even under severe conditions.

A special rubber compound, capable of forming particularly thin walls, is sometimes used for small-conductor control cables because of its compactness. It can be used without a lead sheath in dry locations.

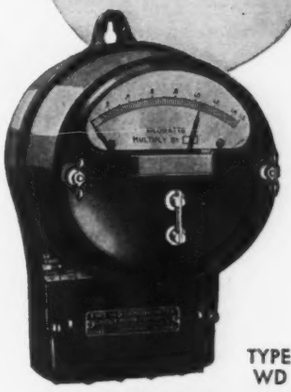
For boiler rooms and other very hot locations *asbestos insulation* is

LINCOLN DEMAND METERS

NO PARTS THAT WEAR



Bimetallic coils and center shaft of actuating element

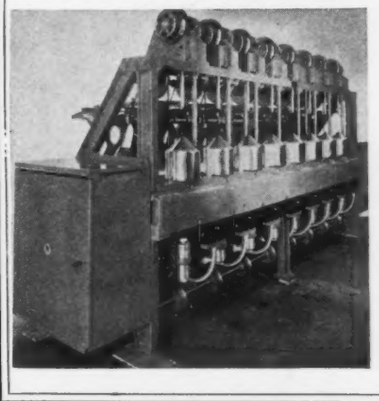


TYPE WD

In the above illustration the arrows indicate the only points of possible wear in the actuating element. Even here the motion is little. There is no appreciable wear in years of service.

SEND FOR YOUR COPY OF CATALOG TO

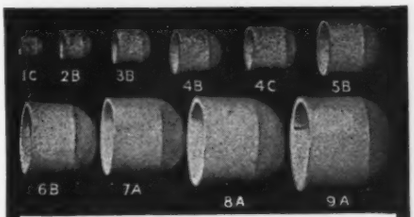
LINCOLN METER COMPANY
SPRINGFIELD, ILLINOIS



No. 2-S-8 S BB Paper Taping Machine
incorporating the following features:

Individual motor drive to each unit with push button control.
Ball bearing mounted throughout.
Automatic stops in event of tape breaking or spent cop.
Adhesive tank for each head.

EST. 1853 AIMCO INC. 1913
"American" INSULATING MACHINERY COMPANY
TRADE MARK
519 West Huntingdon St.
PHILADELPHIA PENNSYLVANIA U.S.A.



STAR INSULATING BEADS
Use Lavolain ball and socket beads for insulating bare wire. Heat resistant. High di-electric and mechanical strength. Made in U. S. A. Quality beads at low cost. Quickly applied. Flexible. *Actual sizes shown above.* Ask for price list and samples.
THE STAR PORCELAIN CO.
TRENTON, N. J.

HIGH GRADE
HARD PORCELAIN
FOR
Electrical Specialties
High and Low Voltages

IMPERIAL
PORCELAIN WORKS
TRENTON, NEW JERSEY

McGRAW-HILL
DIRECT MAIL LISTS

AS business paper publishers for over 50 years, McGraw-Hill is uniquely equipped to offer complete, authoritative direct mail coverage of Industry's major markets. Extreme accuracy is maintained (guaranteed to 98%) and through careful analysis of markets, complete classification of companies and personnel, etc., the widest possible selections are available. Send for handy reference folder "Hundreds of Thousands of Reasons Why" which describes how McGraw-Hill Lists are built and maintained.

What Fields Do You Want to Reach?

Aviation
Bus & Electric Railways
Civil Engineering and Construction
Coal Mining
Electrical Construction
Electrical Industry
Food Industries
Metal Mining
Metal Working Industries
Process Industries
Textile Industries
Administrative Executives
Electrical Dealers & Wholesalers
Mill Supply Houses
Power Services
Product Engineering & Design
Production and Maintenance
Radio Dealers & Wholesalers
Radio Engineering & Design

For further details, selections from above basic classifications, counts, prices, etc., or estimates on special lists . . . ask any representative or write to

DIRECT MAIL DIVISION
McGRAW-HILL PUBLISHING CO.
NEW YORK, N. Y.

. . . Complete Lists Covering Industry's Major Markets

sometimes used for low-voltage cables. Impregnated asbestos is preferred because of its better dielectric properties as compared with dry asbestos. These properties may be further improved by the addition of a few varnished-cambric alkyd-resin or high-temperature varnished-cambric tapes. Asbestos cables require a lead sheath, potheads, and all the usual precautions which are necessary with paper cable.

External coverings

With regard to finishes, paper cables and varnished-cambric cables for use outdoors are usually furnished with a lead sheath. Sometimes a rubber-hose jacket has been used where it is desirable to have a non-metallic finish on cables of these types. Such a finish works very well, but tends to be more costly than the lead sheath. It is, of course, free from sheath voltage and sheath loss problems. A light rubber hose jacket *over* a lead sheath sometimes affords a satisfactory solution where corrosion problems are serious.

Occasionally such protection can be obtained by the use of a duck tape over the lead sheath. This affords a certain amount of added protection where, though corrosion conditions are not really very serious, it is felt some sort of protection is needed. Use of duck tape is less expensive than the light rubber hose jacket mentioned above. At one time it was used very freely whenever open-circuit sheath operation was adopted; today it is not usually considered necessary.

Varnished-cambric cables for use in dry locations, as well as rubber cables, are usually finished with a weatherproof or flameproof braid. The former is the stronger mechanically, but the latter is usually preferred because of its flame-resisting properties. This finish is commonly used in such applications as control wires and switchboard wiring.

Sometimes control cables and small power cables are piled up in steel troughs rather than run in individual ducts. Such cables require something better than a braided finish to protect them against crushing and abrasion, and also against fires which might be started by the failure of one of the cables in the group. A metal armor, flat or interlocked, is therefore, often provided.

The selection of small power leads, lighting leads and control cables for station work is usually a simple matter if due attention is given to the special conditions under which these cables must operate. Where serious problems of congestion and complexity are encountered, or where large generator leads are involved, it is necessary to give the problem special study, since such problems tend to become very complicated in large generating stations.

Operating Costs Increasing

[*Continued from page 43*]

tion, has been an increase of total operating costs from 62.4 per cent to 68.5 per cent, a decrease in net from 26.8 per cent to 19.7 per cent (more than one-fourth).

During the first part of the nine-year period the fixed-charge coverage decreased from 3.07 times to 2.20 times. Latterly despite relatively higher total operating costs, the effect of refunding at more favorable interest rates has been manifested by a rise in coverage to 2.60 times, indicating a stronger position for bonds.

•

Limerick Contest Opens

A nation-wide Limerick contest, sponsored by Leonard division of Nash-Kelvinator Corporation and offering $9,500 in prizes, began March 15, according to an announcement by Walter Jeffrey, Leonard advertising manager. The contest is open to every one except Leonard factory employees. The $1,000 first prize and 87 other awards, which include 25 new Leonard refrigerators, will be given for the best "last lines" to any five of ten uncompleted limericks. The contest closes June 15.

•

Utilities in Philippines

An aggregate of approximately $124,850,000 is invested in public utilities in the Philippine Islands, according to statistics made public by the Philippine Public Service Commission and reported to the Department of Commerce by the office of the American Trade Commissioner at Manila. Of the total, about $80,500,000 is invested in land transportation, about $27,000,000 in electric power plants, $5,350,000 in a gas system, $4,750,000 in a telephone system and $7,575,000 in water systems and ice plants in the islands, the statistics show.